

Network



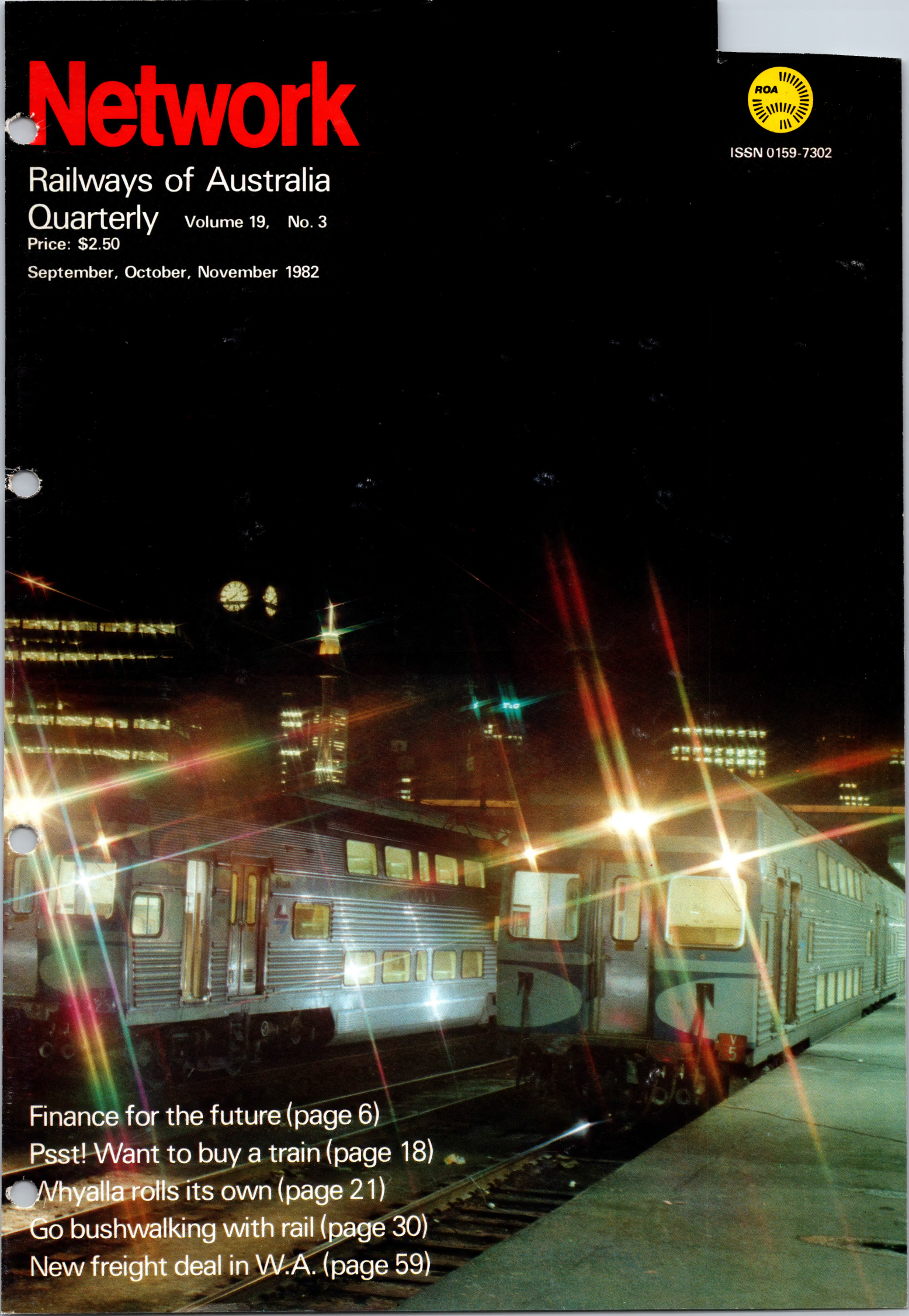
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Railways of Australia
Quarterly

Volume 19, No. 3

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Psst! Want to buy a train (page 18)
Whyalla rolls its own (page 21)
Go bushwalking with rail (page 30)
New freight deal in W.A. (page 59)

Our Kangaroo helped build a \$145 million railway.



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LOCATION: Kulgera
ASSIGNMENT: Crush 800,000 tonnes of rock for rail ballast
DEADLINE: 18 months

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FARLEY

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Railways of Australia Quarterly

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• *Queensland Railways* • *VicRail*
• *Westrail*.

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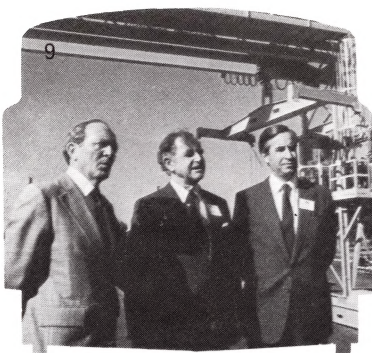
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Front cover:

Here at Central Station in Sydney are two "double decker" suburban consists of the State Rail Authority of New South Wales. These high capacity cars have contributed greatly to the revitalisation of Sydney's suburban system.



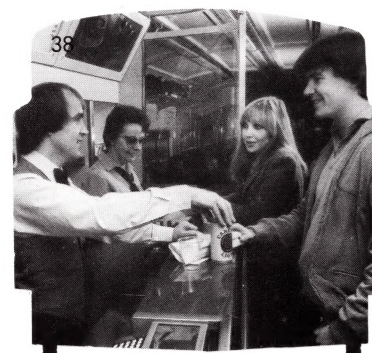
Australian National



State Rail Authority of NSW



Queensland Railways



VicRail



Westrail

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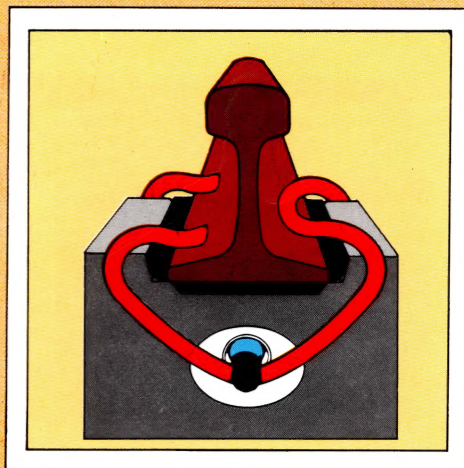
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Our only requirement of writers and personalities who contribute to Network is that they be informative or entertaining and that their subject has relevance to the wide interests of railwaymen today. Naturally, there will be occasions when their viewpoints or opinions run contrary to those of the editor or to Railways of Australia. We must accept that these differences are among the elements essential to the presentation of a lively and interesting magazine.

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Even Lawrence would have respect for Fist-BTR track



Urban transport, crisis and capacity

From time to time people raise the question of whether, in a time of real petroleum fuel crises, our public transport system would have enough capacity to get us all to work. And since the railways have no surplus urban stock, no surplus crews and often no surplus track capacity to increase existing peak-period service, that is a very valid question indeed. I put the very same question to our special feature writer and he replied:

"The simple answer to the question is 'yes — but'. The 'yes' part arises from the fact that on all but a few key trains in the high peak, the 'crowded' travelling conditions of which we complain are but a fraction of the discomfort routinely endured by citizens using big-city subways overseas. If a crisis is by definition a situation where we grudgingly accept the abnormal, it is probably that most peak-period services could uncomfortably achieve 20 to 30 per cent increased loadings.

By the quick expedient of temporarily unbolting and removing some of the seats to create extra standee space in the cars — a far more 'efficient' use of floor area — an even greater increase could be achieved on many car designs, again at a price in discomfort. In the case of journeys to the central business district (CBD) where a large proportion — 80 per cent in Sydney — of journeys-to-work are already performed by public transport, this reserve is ample: the fuel crisis would not generate all that much extra CBD rail traffic.

The 'but' qualification applies to the vast majority of non-CBD inter-suburban journeys, currently handled by private cars because public transport is not well-g geared to serve 'circumferential' rather than 'radial' trips.

But in a real fuel shortage, many of these motorists would undoubtedly switch to more roundabout public transport, including rail. Innovative emergency planning might divert buses from journeys right into the CBD to feed the nearest station, or to provide new cross-suburban services for the duration of the crisis. And employers are likely to provide car-pool or other transport to local stations. All these options have the potential greatly to increase suburban railway loadings, both on journeys into the CBD and back out another radial 'spoke' of the system, and to and fro within parts of each spoke. Given a finite public transport vehicle fleet that makes on average only 1.1 to 1.2 loaded trips per peak, there is only one way to cope with any emergency surge back to rails: to increase the loaded trips. This means "broadening" the peak to increase the total

offer of capacity. The best way to achieve this, and preserve reasonably civilised travelling conditions, is to adopt staggered working hours for the duration of the crises.

Public transport authorities have been preaching this gospel on deaf ears for the past 40 years. One day they will be heeded.

Brave words, but does the above solution actually work? The experience of Stockholm during the 1973-74 fuel crisis is a useful pointer, for then as today, the Swedes totally lack indigenous crude oil or synthetic fuel.

Greater Stockholm has a population of 1.35 million, a very high standard of living and 264 cars per thousand people. 35% of journeys to work downtown are by motor car; 16% of the CBD workforce have company-supplied cars which they garage downtown, and 90% of all the cars driven into town are parked free. In normal times, the number of people making downtown journeys by car (for all purposes) ranged from 35 to 60 per cent of trips, according to originating suburban region. This is a situation far worse than Sydney or Melbourne.

In contrast 80-85% of the Stockholmers live within the catchment areas (walk or walk / bus) of either the unified surface electric railways network, which runs across the CBD and is operated by the Swedish State Railways (SJ), or the physically separated subway network (SL) run by the Stockholm County.

Both rail networks are 'spokes of the wheel' CBD-oriented systems, and Stockholm had 224 SJ suburban and 700 SL subway cars and 1525 buses when Sweden was hit by drastic petrol rationing almost ten years ago.

Downtown journeys by car immediately dropped by one half to two-thirds. Many of the remainder car-pooled. Most firms accepted extended hours, creating a defacto staggered working hours situation.

And what happened? The SJ suburban patronage increased by an incredible 60%.

The suburban train fleet was augmented 9% by recommissioning two old wooden electric locos and 16 disused coaches as two complete trains. Thus equipped, the railway handled the extra load. Comfortably, too, because the patrons had sensibly spread the load. No change was made to SL's subway operations beyond extending the duration of morning and evening peak period services to match the demand. Both systems augmented their off-peak services using rolling stock that would normally have stood idle in slack hours.

The people got to work and play, the railway folk enjoyed unprecedented overtime



N. J. Gazzard

opportunities, and the public transport deficit dropped remarkably. Everybody pulled together, and nobody went on strike, or cold, or hungry. The normal life of one of Europe's great cities was preserved — by the railways.

Something to think about, perhaps, when next you hurry down the ramp and never spare a glance for that friendly, familiar sign "TO SUBURBAN TRAINS".

N. J. GAZZARD
EXECUTIVE DIRECTOR

When ARRDO (the Australian Railway Research and Development Organisation) was set up in 1977, its brief was to help Australian railways to improve their financial position. Between 1970 and 1976 a surplus of about \$100 million over working expenses had turned into a total deficit of nearly \$800 million. One of the areas of railway management in which help was needed was investment planning and ARRDO has been and continues to be heavily involved in research on this topic.

Rail needs investment funds so that it can continue to replace rail assets as they reach the ends of their economic lives; provide replacement or additional assets which will increase productivity; compete for new traffic, and increase service levels.

The size of investment concerned is considerable, with about \$450 million being spent annually in Australia (in 1979/80 dollars), excluding special projects such as the Melbourne underground rail loop. The assets involved include 2000 locomotives, 60 000 wagons and 40 000 kilometres of track.

ARRDO has carried out two main types of investment study to date:

- a broad overview of the investment needed over the next five years if rail is to perform efficiently; and
- a detailed examination of investment possibilities in mainline freight, the largest and most commercial of all rail business sectors.

Overview of Investment Needs. At the time the overview of investment was needed, there was neither the time nor the resources to carry out a piece by piece evaluation of asset requirements. Instead, it was necessary to adopt an approach that would allow a reasonable estimate to be made quickly.

The technique used to provide this broad estimate of investment requirements involved the use of capital:output ratios. That is, the ratio between the amount of capital stock a rail system owns and the amount of traffic (output) that this capital enables it to handle. Using forecasts of expected traffic flow, it is possible to apply the ratio to estimate the amount of investment which will be required several years in the future.

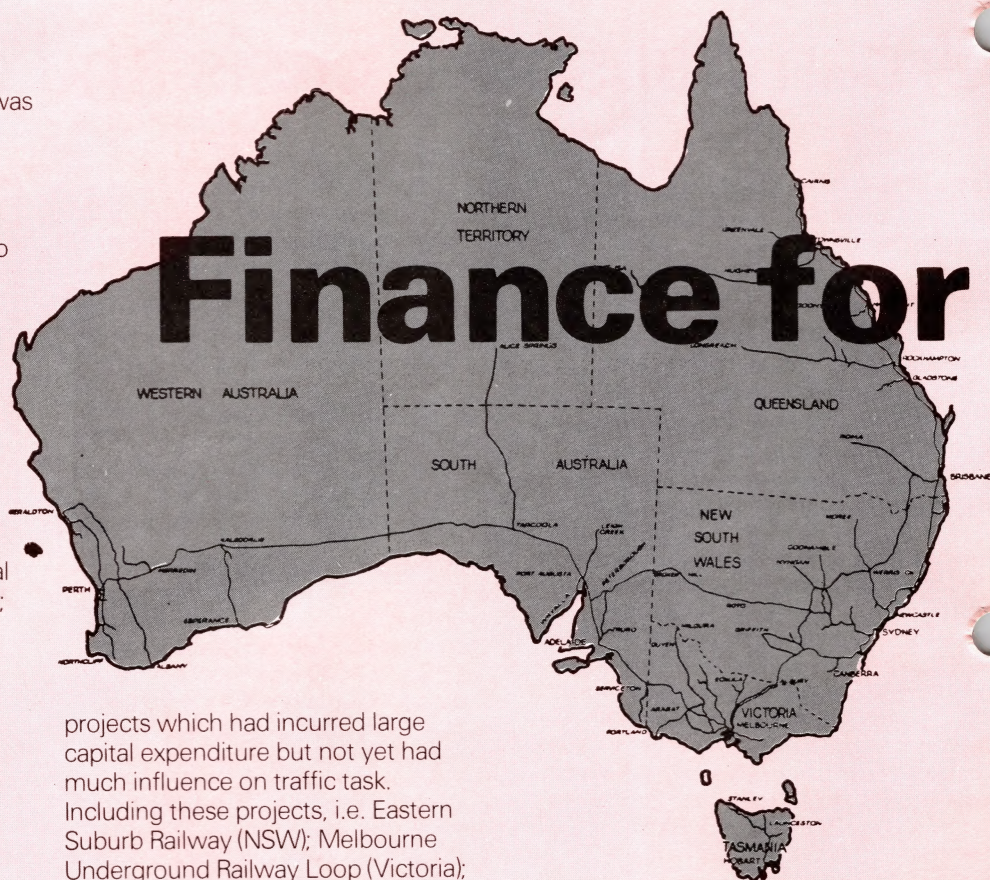
Information from previous years was used to work out a capital:output ratio for each of the rail systems for 1968/69 and 1978/79. The ratios for 1978/79 excluded capital-intensive

projects which had incurred large capital expenditure but not yet had much influence on traffic task. Including these projects, i.e. Eastern Suburb Railway (NSW); Melbourne Underground Railway Loop (Victoria); Suburban Electrification Project (Queensland); Tarcoola to Alice Springs line (AN); would have led to an over-estimate of the capital stock needed for the 1978/79 traffic task.

This work showed that there had been little increase in the capital value of Australia's railways between 1968/69 when it was \$3.80 thousand million, and 1978/79 when it was \$3.83 thousand million (excluding the \$670 million tied up in special projects). To estimate output, the freight and passenger tasks were combined into a single measure of task based on the relative costs of serving these business areas.

The following table shows calculated capital:output ratios. From the table it can be seen that the SRA needed 8 cents of capital stock for each traffic task kilometre of output in 1968/69, while it needed 9 cents in 1978/79 (all in 1979/80 dollars). However, in all other systems, the ratio has decreased.

Rail System	Capital:output ratio (cents/traffic task kilometre*)	
	1968/69	1978/79
SRA/UTA	8	9
VicRail	12	10
QR	17	8
Westrail	23	11
AN	17	11
Average Australia	12	9



* 1979/80 dollar values

Changes in capital:output ratio arise for two major reasons:

- the output increases or decreases but capital stock is not adjusted to the same extent;
- the capital stock increases or decreases but output does not change to the same extent.

For example, in Victoria the capital:output ratio of 12 in 1968/69 had decreased to 10 by 1978/79. This was because the value of the capital stock had decreased by thirteen percent over the period, while the traffic task had remained the same. This implies that the level of service provided declined over this period, or that there had been a substantial improvement in capital productivity over the period, or a combination of the two.

As mentioned above, using capital:output ratios and an estimate of future traffic task, estimates can be obtained of the size of the future capital stock needed and the required investment rate over the intervening period.

The results of this work are presented in the 1981 Report on Rail which was published by ARRDO earlier this year and are summarised in the diagram Fig. 1.

the future

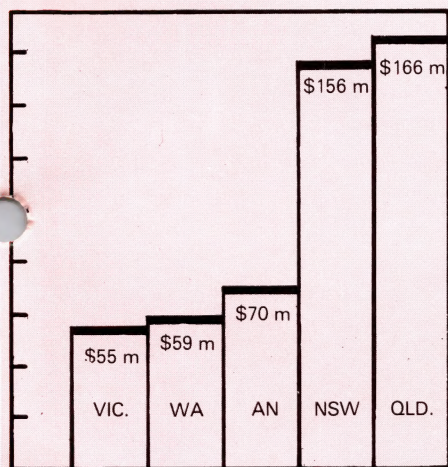


Fig. 1

In forecasting capital requirements, some assumptions must be made about level of service. As past trends in capital:output ratios are used in estimating investment needs, the resulting level of investment will lead to the continuation of past trends in service level, at a constant level of capital productivity. Two rail systems, SRA and VicRail, have pointed out that such service levels would be quite unsatisfactory to their governments. These systems have indicated that they will be arguing for increased funding above the levels suggested by ARRDO.

Investment in Freight Traffic. The second aspect of ARRDO's investment work was the detailed investigation of national freight traffic — the National Rail Investment Study. This work is also described briefly in the 1981 Report on Rail.

The study concerned the National Mainline Freight Network which comprises all lines which are:

- state intercapital links, or
- extensions from state capitals to adjacent ports; or
- routes carrying in excess of two million gross tonne kilometres per kilometre annually; or
- lines declared national lines under the National Railway Network (Financial Assistance) Act 1979.

The resulting Network consists of about 150 line sections and 22,400 route kilometres. It is comparable to the network of national roads now funded by the Commonwealth.

The aim of the investment study was to develop a technique for assessing the contributions to the profitability of freight traffic of investment in various aspects of the operation. Those considered were:

locomotives	bridges	electrification
wagons	signalling	terminals
track	crossing loops	workshops

Techniques were devised to estimate the resulting benefits and costs of investment in each of these areas.

These were compared with the benefits and costs that would arise without investment. To this extent the approach is identical to standard cost/benefit analysis. Since the purpose of the work was to gain a broad appreciation of overall investment needs, rather than detailed information on a small number of specific investment opportunities, the techniques were designed to be simple and general, and a small margin of error was considered acceptable. This error may lead to overstatement of warranted investment in some areas and understatement in others, but the overall bias is toward understatement. An example of the general approach is the study on investment in locomotives. This is concerned mainly with the need to replace old locomotives in the fleet.

Preliminary investigation suggested that there are three main effects of locomotive replacement. First, each new, powerful locomotive can replace more than one old locomotive. Second, maintenance costs are reduced. Third, fuel efficiency is improved. Secondary effects are greater reliability in service and improved conditions for train crews.

Information was gathered on the numbers and characteristics of

locomotives (grouped into classes) currently in use. Experts within rail systems then provided assessments of the numbers and characteristics of locomotives that would be required to replace each class. Historical costs of maintenance for a number of locomotive classes over a ten year period were then analysed to develop a model of how costs increase with age. The percentage improvements in performance which would result from replacement were estimated from earlier ARRDO studies of fuel efficiency (litres per gross tonne-kilometre). The secondary benefits of investment as noted above were not included, and so the end results of the evaluation are likely to be conservative. Computer programs were written incorporating each of these cost and benefit functions so that large numbers of replacement proposals could be evaluated easily. Output was in a form which allowed comparison with results from similar investigations of investment in other assets.

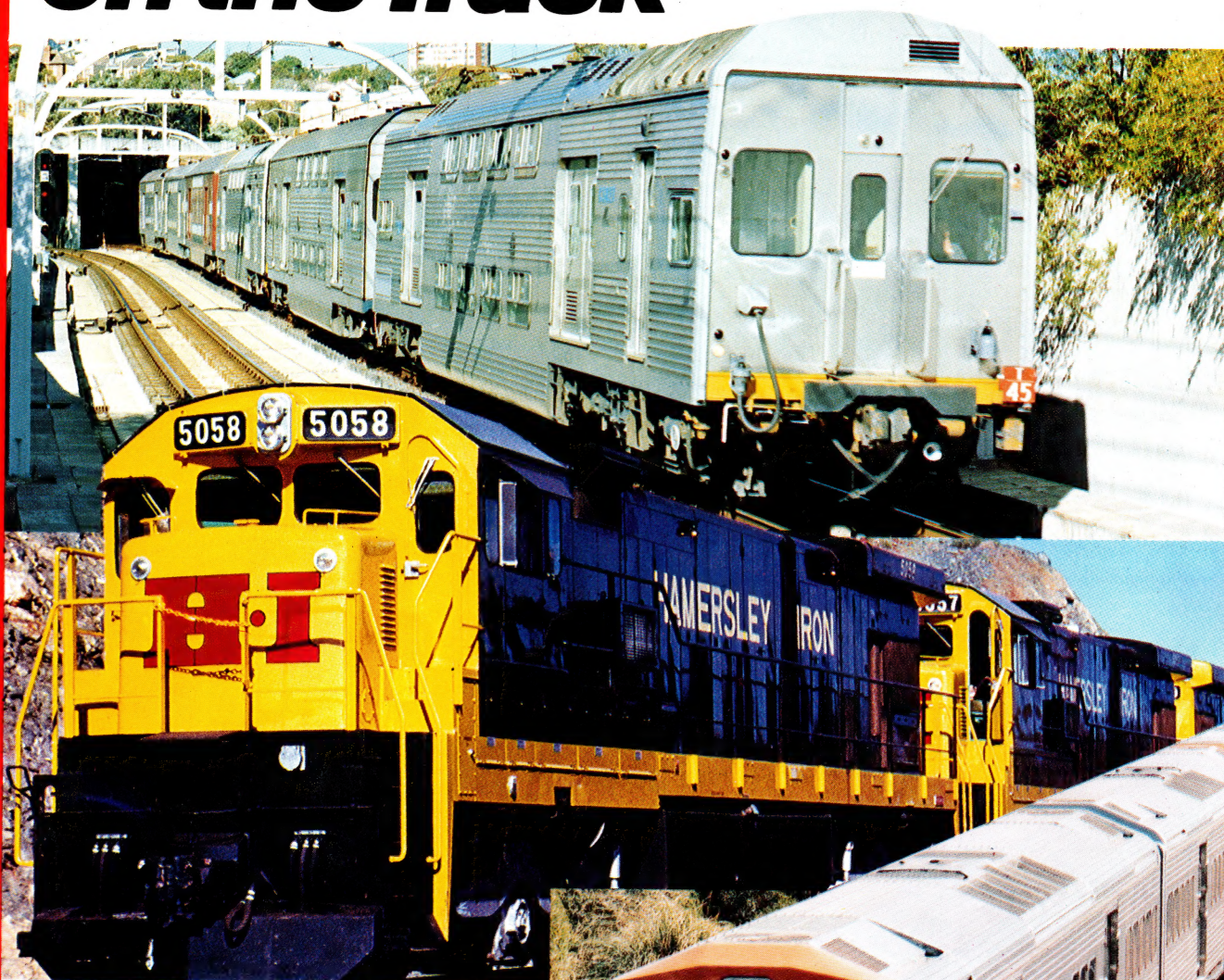
Wherever possible, a similar approach was taken for investigation of each of the other areas of investment. In some cases, such as improvements to terminals, the effects of investment are very local and so a general approach to evaluation was not feasible. In other cases, the effects of replacement of small items of plant and equipment could not be evaluated cost effectively and so by leaving them out, the estimate of the overall level of warranted investment became even more conservative.

This work resulted in the preparation of an investment package showing where worthwhile investment could be made. Again, a need for increased funding was apparent, and the study recommended that, to assist in meeting this need, funds for track and track-related investments under the National Railway Network (Financial Assistance) Act, 1979 should be raised from the current level of \$14 million per year to \$83 million per year from 1 July 1983 (1979/80 money values). This would put National Rail on a more equal footing with National Roads.

The Future. This year ARRDO is starting work on a focussed investment study which will lay the foundation for future extension of its work on this topic. This work will culminate in the preparation of a comprehensive rail investment program.



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GRP/178216

A major rationalisation of railway operations in South Australia's Riverland area has been implemented with the opening of Australian National's new freight centre at Loxton.

One of AN's least publicised projects, despite its potential impact on rail operations, the \$2 million regional terminal is the first of its type in South Australia. Aimed at dramatically improving cost and operating efficiency of the railways in the area while improving the service, it is expected to attract additional freight traffic to rail. The centre will serve as an intermodal transfer and distribution point for AN road collection and delivery services to other towns in the Riverland.

The five main towns of this major fruitgrowing region have been served by three separate railway lines radiating through the Murray Mallee area from Karoonda. Waikerie and Loxton, south of the Murray River were each served by separate lines, while Renmark, Berri and Barmera on the north bank were served by one circuitous route via the Paringa bridge at Renmark.

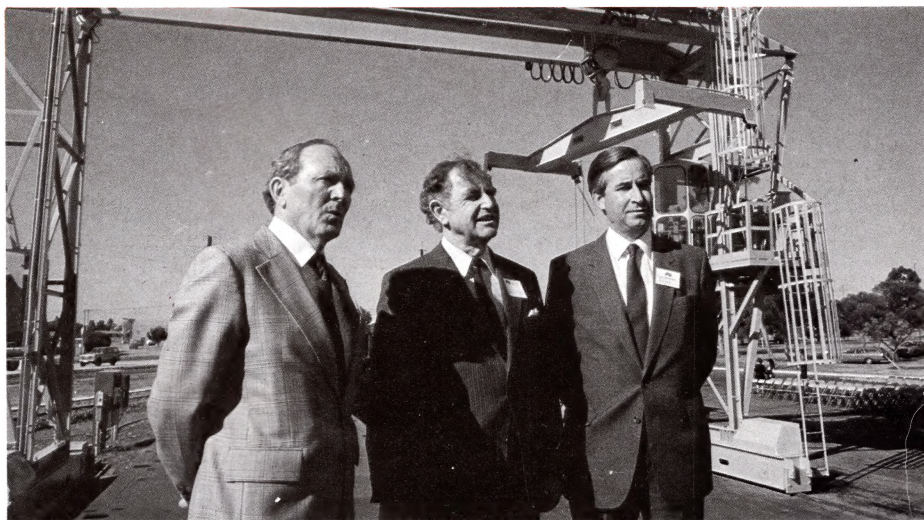
Australian National's service to the Riverland was a prime example of a circuitous route — Loxton just south of the River Murray is 159km by rail from Tailem Bend. Berry 22km north of Loxton on the other side of the River is 242km by rail from Tailem Bend. It was obvious that the relatively light traffic generated by the five towns and a few well-spaced grain silos was not being effectively serviced by three separate routes.

Explaining the development of the concept of the Loxton freight centre, AN chairman, Mr Lou Marks, said that commercial viability as required by the Government means not only achieving a financial return of the nation's investment in railways but also providing modern efficient transport services.

This centre is the first of its kind in Australian National's area of influence and its opening is the culmination of a planning process which really began in September 1978 when AN officers commenced a study of similar projects in other states.

By May 1980 Australian National was able to publish the result of their study — which was a proposal to establish a regional freight centre which would serve the transport needs of the Riverland area of South Australia.

The study demonstrated that a freight centre at Loxton would enable AN to rationalise its important Riverland operations, improve the level of service



The Federal Minister of Transport and Construction, the Hon. R. J. Hunt, opening the Loxton Freight Centre. With him are the Chairman of Australian National, Mr L. E. Marks (left) and General Manager, Dr D. G. Williams (right).

AN opens new freight centre at Loxton

it was able to provide and at the same time reduce costs.

Intermodal. Establishment of the freight centre at Loxton required virtual reconstruction of the railway yards on a confined site to cope with longer, heavier trains and the intermodal nature of the traffic.

A 20 tonne capacity travelling gantry crane (ex Hobart, Tasmania), rail track and paved roadway were constructed on the southern side of the Loxton-Berri main road. This has been provided for containerised and heavy loads such as agricultural machinery. Two weighbridges had to be shifted for their new roles.

On the site of the original station yard, additional sidings, a large (30m x 18m) covered loading area and paved standing area for road vehicles was constructed, while a modern new freight office will shortly replace the ageing Loxton station building. Among the materials handling facilities now provided at Loxton are mobile cranes, fork-lift truck and a road/rail mobile crane which doubles as a shunting tractor.

Decanting equipment for liquefied petroleum gas (LPG) has also been provided. A substantial wheat silo already exists in the Loxton yard. The existing stations at Waikerie, Barmera, Berri and Renmark have become AN depots manned by a freight agent. Clients may deliver goods to, or collect

goods from, these depots, although it is envisaged that most goods and parcels will be delivered to or collected from client's own premises.

Road transport between Loxton and other Riverland towns will be by AN and private carriers with delivery arrangements made by AN staff. AN vehicles will carry less-than-wagon-load consignments, while the private carrier will carry wagon loads under contract to AN.

Co-ordinated. Rail services to Loxton will vary during the year but are initially being scheduled to provide a daily return service four days a week. Freight trains will operate overnight between Adelaide, Tailem Bend and Loxton to provide deliveries to businesses in the Riverland early in the morning by the co-ordinated road delivery service.

Rail services will cease completely on the route between Paringa, Renmark, Berri and Barmera. On the routes between Karoonda and Waikerie, and Alawoona to Paringa, regular services have ceased but freight trains will continue to operate as required for bulk loads such as grain and fertiliser or other traffic offering in minimum train loads of 400 nett tonnes.

The official opening of the Loxton Freight Centre took place on June 16. Federal Minister of Transport and Construction, the Hon. R. J. Hunt, when performing the opening ceremony said: "Transport infrastructure is of such fundamental and vital importance to the development of this vast island continent. "Railways are, of course, an essential mode of transport. They will continue to remain a vital element in the transport system so long as; they tailor their services to customer demand."





During the coming months an ever-increasing number of railway staff and freight clients will hear mention of the term "INTRANS". What exactly is INTRANS?

The Railways of Australia Intersystem Transport Operating Plan — to give INTRANS its full title — has been founded on detailed analysis of the changing requirements of rail freight operations, and uses to advantage the technology now available through electronic media.

INTRANS —

Basically INTRANS will offer considerable improvement to long distance interstate rail freight movements in Australia. All Australian Railway Systems have worked together closely over the development of the plan, and project teams involved in the development have been motivated by the basic transport requirements of railway freight customers.

The Sydney based consulting organisation of R. Travers Morgan Pty Ltd have provided a co-ordinating role for the project, undertaking wagon transit surveys and other operations research.

Detailed analysis work has also been completed by teams of railway officers seconded to the INTRANS project, visiting every major interstate station and inspecting operations on a day by day basis. Both railway staff and the all important clients have added to the input from the project team. Wagon transits have been traced through the System on all major intersystem routes and delays pinpointed. Records at bogie exchanges, wagon turnaround times and wagon downtime as well as costs; of repairs were all placed under close scrutiny.

These investigations revealed that while some improvements could be effected at a local level, major and sustained improvements could only be achieved by a programme of co-ordinated activities at a national intersystem level. In short, an intersystem Transport Operating Plan. The proposal for this INTRANS plan was then submitted to Commissioners. At their Annual Conference in Brisbane in 1981, Commissioners from all Systems unanimously endorsed the INTRANS concept, and approval was given for detailed development and implementation of the Plan.

INTRANS will incorporate:

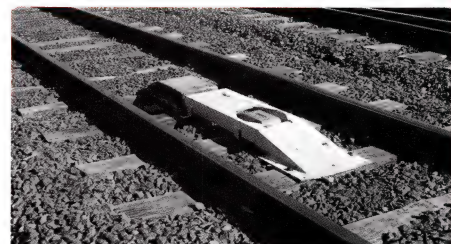
- Planning of through train loads between cities
- Intersystem working of locomotives
- Standardisation of train examination procedures
- Improvements in freight terminals



The TMS "nerve centre" in Wellington where the TMS computer is based.



Freight train in Western Canada (Canadian National).



Wagon monitoring transponder.

BOLD PLAN FOR THE FUTURE

- Centralised transit monitoring of intersystem wagons

Progress has already been made in several of these areas. The completion of the standard gauge link between Crystal Brook and Adelaide later this year will make INTRANS more viable, as delays are eliminated at the bogie exchanges in Peterborough and Port Pirie. The new bogie exchange at Dry Creek (Adelaide) is approaching completion and will provide a fast and flexible high capacity facility for through wagon movements between Victoria's broad gauge and the standard gauge network.

This new Crystal Brook-Adelaide capability will provide direct standard gauge freight services between Sydney/Adelaide and Adelaide/Perth. Services operating via the new Dry Creek bogie exchange will enjoy reduced overall transit times. The INTRANS operation will contribute greatly to these movements.

The expanded CENWAG (Centralised Wagon Control) will play a vital role in the INTRANS operation. Acknowledged to be extremely successful in Centralised Wagon Control and deployment of RACE (Railways of Australia Container Express) containers, CENWAG is currently gearing up to monitor intersystem wagon transits on a centralised basis. With the introduction of an information processor, CENWAG will provide the essential monitoring facility.

The Railways of Australia Committee will soon release an information bulletin which provides details on the INTRANS concept. As more and more railway officers become involved in the INTRANS project, a clear understanding of its operation is important to all levels of staffing and management.

Through projects such as INTRANS Railway Systems in Australia are confident they can contribute greatly to the herculean transport tasks confronting Australia in the future. However, in common with other Railway Systems the world over, effective utilisation of rollingstock is of

paramount importance. Accurate monitoring is therefore essential. How is this analysis undertaken?

"Network examines overseas trends in wagon monitoring, and the various systems in operation."

What information is required to enable wagon monitoring to succeed? At first glance the relationship between assets inventories and wagon monitoring systems may lack clarity. However, an important data item relating to any asset is "location".

If a wagon register incorporates such data, and it is kept up-to-date on a frequent basis, we have the base for a wagon monitoring system, which is an essential pre-requisite to implementation of any form of wagon control. "Frequency" does not necessarily equate to "regularity" in this situation, as updating might be on either a regular or irregular basis. However, the frequency of updating must be such as to adequately reflect the time frame within which wagon movements occur.

It should be emphasised that mere wagon tracing via a wagon monitoring system, in itself, is not the major objective; the wagon monitoring system is merely the mechanism by which sources of wagon delay and under-utilisation may be identified — rail management must subsequently determine and implement appropriate corrective action.

The information system itself is only part of the overall control process and in particular circumstances may be effectively established without the necessity to introduce computers — as evidenced by the CENWAG operation. Where the capability to identify the movements of individual wagons is desired, however, the volume of daily transactions would generally warrant consideration of computerisation of the data base.

Wagon utilisation. The declared objectives of CENWAG operations were identified as being to obtain:

- maximum use of rollingstock capacity

- satisfaction of market requirements
- balanced flow of traffic through bogie exchanges
- avoidance of unnecessary haulage of empty wagons
- reduction of the cost of the traffic task to all systems
- ability to cope with traffic growth with minimal capital investment in new rollingstock.

Utilisation is improved by increasing the number of loads carried by a given fleet or reducing the fleet size for a given demand. If it is desired to maintain a given level of service whilst reducing fleet size, utilisation must be improved by reducing the wagon cycle time and/or proportion of time the wagon is not in traffic.

However, there are direct and indirect conflicts between objectives based on the above measures. For example, reduction of the Australian fleet of ageing four-wheelers is being achieved both by "trimming off the fat" and more intensive utilisation. However in the medium term, the need for more extensive maintenance consequent upon this more intense usage may increase the average time a wagon requires for maintenance, and if maintenance resources are not boosted accordingly, the proportion of fleet out of service must further increase. It is critical therefore to trade-off improvement in the various operating performance measures to ensure optimum wagon utilisation consistent with providing an adequate level of service.

Before going on to consider the role of a wagon inventory, by CENWAG, in a wagon monitoring system in the Australian context, it is useful to consider in some detail the development and application of some of the more well-known of such systems overseas.

Overseas Systems

St. Louis-San Francisco Railway

Whilst it is not known which rail system was the first to explore the use of data processing devices for wagon control



purposes, as long ago as 1952, the St. Louis-San Francisco Railway Company in the United States installed IBM key punch, paper-tape to card and card to tape machines, card-sorters and printers at six major terminals. This system required the gathering and transmission of the usual data necessary for road and yard movement of both loaded and empty wagons. The end product was wagon hire information for the office, whilst in the field, it produced mechanical preparation of outbound train consists and wheel reports, and the availability to transmit advance consists to terminals, prior to arrival of train. The benefits from this early system were reflected in the expedited movements of wagons and trains through yards and terminals. On the clerical side, savings were made by the mechanisation of the consists, wheel reports and of the wagon record reports.

In 1958, this system was expanded to provide for both consignor and consignee information. At the same time, the first perpetual wagon location inventory systems were installed in the terminals where they had the IBM cards. Placement of wagons and releases from sidings were reported to the yard office and as the wagons were shunted, the cards were "switched" and shunting lists and daily yard checks were produced mechanically, for both train and data.

In 1965, the Company made its first attempt at MICS "Management Information Control System"; In 1970, it went on-line. This established a central base covering each status change in sequence for each wagon, trailer, container, engine, guards van, waybill and train. Each change of status is reported from the field in the same sequence that it occurs.

This provides a data bank available to users for minute to minute or day to day monitoring of operations through inquiry.

At the same time, as needed, information is extracted on magnetic tape for preparation of periodic reports.



The movement of wagons, trailers and trains is, however, married to paper work as both loaded and empty equipment is waybilled.

Before data is permitted to enter the system and be posted to files, every effort is made to ensure its accuracy. All activity reports are subject to very rigid on-line edit and then checked against several on-line master files, including UMLER (Universal Machine Language Equipment Register). Records that fail to meet these criteria are rejected to field input stations for correction. There is also continuous monitoring to ensure continuity of activity reporting.

In addition to the random access capability and data extracted for periodic reporting, certain data is passed aside to other disc files on the real time computer and printed reports for management purposes are automatically printed at specific intervals. Similarly, reporting of wagon location information is automatically transmitted via telegraphic media to on and off line sales offices, over 200 customers and to other railway companies.

The waybill is the basic record for the MICS system. This MICS provides the data base for at least 75 % of all information required for monitoring and controlling operations of the railway.

Canadian Pacific Canadian Pacific concluded many years ago that wagon utilisation needed to be improved substantially. To that end it developed a comprehensive car management scheme, which in essence centralises the planning and control of every activity associated with the use of freight wagons and monitors the results through a computer file that is updated on a real time basis. The scheme provides for a computerised wagon file by number, type and location transmitted to Headquarters every time a wagon passes a reporting point. Direct updating of the file is provided together with direct access to it by wagon controllers.

There are four controllers for the whole of Canadian Pacific, who direct all empty wagon planning.

There is a diagram panel which shows the status of the wagon fleet diagrammatically, allowing staff with their experience to see where shortages are developing and where surpluses exist so that the appropriate action can be taken to move wagons to meet these requirements. There are in fact three systems, the main one for general purpose wagons, and two sub-systems, dealing respectively with petroleum tankers and grain hoppers. In the case of petroleum tankers and

grain hoppers, the records show both loaded and empty containers at all times. In the case of the general purpose vehicles, the diagrammatic display is of empties only, it being presumed that loaded wagons have been routed and are moving as efficiently as possible.

It is considered that it will be necessary eventually for empty wagons to be waybilled for total field control. Aside from the control section and the wagon management centre, two planning sections are incorporated in the overall system; these deal with a car management program equipment planning and utilisation.

The function of these two sections in essence is to:

- co-ordinate the development and maintenance of a fleet profile and to plan short and long term car management activities to develop effective equipment utilisation;
- co-ordinate all those activities associated with the movement of cars, such as the control of perishables, weighing functions and other car management related to computer programmes;
- provide for the development of analytical information fleet performance and the application of this information for preparation of physical and financial measurements of performance.

It is considered that these analytical and related activities are vital to the continued improvement of the control of the wagon fleet.

The other part of the centralised management control system concerns train management, essentially concerned with the allocation of locomotives and guard's vans, again diagrammatically indicated in the same way as for wagons but including some train information. A complete diagrammatic display of the locomotive units by number for each train in operation in the system, the units in the shops, and the units available in the various yards, is maintained on a real time basis.

While this office is run by the Transportation Organisation it has seconded to its staff on a permanent basis a mechanical officer; whose function is to keep diagrams updated with locomotive maintenance requirements or action needed because of partial or complete locomotive failures while on a train. This officer is responsible to the Chief Mechanical Engineer but works very closely with the Transportation Branch

to keep trains moving at all times, and is able to give such directions as it may be necessary to enable a train to reach a point where a unit can be substituted with a minimum disruption to the service. This is similar to the locomotive maintenance planning in New South Wales.

Total Operations Processing System — TOPS.

As its name implies, TOPS is somewhat more than a wagon monitoring system, although the name often crops up during discussion of wagon monitoring. TOPS was developed by the Southern Pacific Transportation Company in the US and has been adopted, albeit in modified form and/or under a different name, by many US and foreign railways including British Rail, Canadian National, and Missouri Pacific.

Its initial operation commenced with Southern Pacific in May 1968, but it has been expanded or modified on almost a monthly basis since then! It was originally designed to provide the means for real time control over the movement of SP's assets and to supply up-to-the-minute information to various branches including Operating, Transportation, Accounting and Marketing.

A consignor or consignee can ask the nearest Southern Pacific sales office, anywhere in the country, for a status report on a wagon, and can get his answer from the central computers in San Francisco in an average of 3.5 seconds.

In addition, over 350 consignors — those with many wagons moving, or with regular freight movements with "assigned" wagons — subscribe to Southern Pacific's CARLOC (car location) program.

The computers scan the inputs watching for the 210,000 assigned wagons on American railways and at either 8 or 24 hour intervals, a concise, standardised report is sent to SP's nearest traffic office, or in some cases direct to the customer, telling the individual customer what has happened to those wagons which are on SP lines.

TOPS monitor the performance of up to 120,000 freight wagons which might, on a given day, be on SP's 22,500 kilometre railway network, in 850 freight trains, over 200 major yards and terminals, or on some of more than 130,000 industrial service track locations.

There are over 500 TOPS reporting terminals, at more than 400 key Southern Pacific locations across the country, linked in direct two-way



communications with the SP's San Francisco computer centre. This telecommunications network uses microwave as a reliable, high-capacity system to carry most of this huge message load, and Southern Pacific has the largest private microwave network in the world — a system spanning over 11,000 kilometres.

TOPS helps wagon distributors locate and schedule empty wagons for delivery to shippers, and tells them if the empties are delayed or diverted, in time to get others; operating officers plan work assignments on the basis of advance reports of incoming traffic.

These aspects of TOPS clearly relate to wagon monitoring and provision of the information necessary for wagon control. But TOPS now performs about 300 other functions as well!

Clearly TOPS is oriented to very large rail systems which can afford the costs of such levels of integration — "initial" (to 1972) development costs of TOPS amounting to \$22m (US), with British Rail investing £32m sterling for its installation of TOPS between 1973 and 1975.

Canadian National Active development of CN's Traffic Reporting and Control System (TRACS) commenced in 1971. From the outset CN wanted something more than "just an information system"; it wanted:

"a set of integrated control systems relating to the whole Traffic-Transportation-Accounting Area and based on cybernetic principles."

Such systems require the ability to forecast events or situations, to compare them with pre-set standards or objectives and to feed back the exceptions so that corrective action may be taken in advance to achieve the objective.

Initial resource requirements for TRACS development were estimated at \$40m (Canadian) over five years, even though the TOPS software was used in establishing the data base.

As time went by, CN appreciated that what it required was a useful information system. When CN began



working with TRACS a great variety of detailed data was extracted from what was entered into the central processing unit. In a way, the system suffered from overkill; too much data were being distributed, even for a railway of CN's size. Rather than discard the data, CN set up a team of wagon utilisation experts to refine the car status data in TRACS.

Data from TRACS along with other information ("TRANS with significant additions") is summarised into the single-sheet "Current Fleet Action Report" which is distributed to all levels of management concerned with freight wagons. This report serves to co-ordinate the functions that are the keys to productivity of the wagon fleet, whilst all still have access to the TRACS monitoring system which automatically identifies wagons which have not changed location in four days. The increased emphasis on co-ordinated, co-operative teamwork is credited with increasing wagon utilisation by 31 percent, between 1975 and 1979, reducing wagon cycle time from 17 days to 12 days.

Association of American Railroads (AAR). In 1970, US railways inaugurated TRAIN, a computer/communications network linking participating rail systems with the AAR in Washington. The system was intended to improve the wagon distribution decisions of AAR's equivalent to CENWAG, by providing up-to-date information on the location and movements of the wagon fleet. Whereas input to TRAIN consisted solely of wagon interchange reports, the input to its successor, TRAIN II, which was implemented five years later, consists of a considerably expanded data set: wagon interchange reports; reports of wagon crossings of regional boundaries; waybill data; records of loadings; records of unloading; record of arrival at destination; "carding" reports; storage and hold status.

The computer processes of TRAIN II include: wagon movement and waybill processing; statistics generation; report generation; on-line enquiry capability; communications control. Editing and updating of wagon movement and waybill transactions is performed on an hourly batch basis. In addition to providing information to AAR's central distribution agency, TRAIN II provides information to the wagon monitoring systems of participating railways in respect of:

- reporting to the owning system of the inter-system interchange of its wagons;
- optional interchange confirmation reports;

- reports on "last commodity carried" for empty wagons transferred to a system;
- on-line enquiries relating to: wagon last location; missing waybill details; waybill details for oncoming wagons; service measurement; pool management
- message switching of administrative data, etc.

Of particular interest to this project is the inventory of assets known as UMLER, Universal Machine Language Equipment Register, which contains for each wagon, up to 16 fields of non-confidential data relating to hire-rate or mechanical details, and which is fully accessible to enquiry from any source. This register is updated on a daily basis and each of the 96 participating railways can get a daily transmission of changes, in order to update its own copy of UMLER (usually maintained only for those wagons on or approaching its trackage), or it can choose to get a new magnetic tape every 15 days.

It is important to appreciate that even with such a highly sophisticated and automated system such as TRAIN II, that the system can be only as effective and reliable as the data that goes in. The AAR noted that for April 1980, 9.5 percent of all freight wagon interchanges that took place and should have been reported to TRAIN II, were missed by one or both of the partners in the move, or, as they showed up in the data received, were so illogical (between non-connecting



"Tanktrain", Essexville, Michigan, USA.

railways for example) as to be rejected. At some 300,000 reports a day it leaves a lot of wagons in limbo!

New Zealand. New Zealand Railways has devised its own Traffic Monitoring System (TMS) to keep track of freight rollingstock. The first TMS centre was set up at Napier in February 1979 and seven other centres have since been brought into operation, the last at Christchurch in December 1980. The decision to implement the TMS scheme nationwide followed six years of local and overseas investigation and four years of successful operation of a pilot system on the Woodville-Napier-Gisborne line.

TMS involves the debiting and crediting of wagons to a particular station or siding. Visual display units at TMS centres constantly feed updated traffic data to a central computer in Wellington which in turn provides an on-line service to other centres.

The time wagons spend in an area is also recorded and if a wagon is registered as being on a train, the computer stores this information until advised by the TMS centre of its detachment.

Visual display units (VDUs) linked to the computer enable queries on the availability or location of a particular wagon to be displayed on a screen at the centre, and printer attachments can print out the information.

The types of reports available on-line are listed below.

Vehicle Enquiry. This report supplies information on the current location and status of individual vehicles; commodity carried is also included. It is possible to recall information for the previous two movements or status changes of any wagon or locomotive.

Train Enquiry. This report provides a listing of wagons on a train, where they joined the train, their destination, the commodity they are carrying and their mass. It also calculates the total mass of the train and its crossing length in terms of four-wheeler equivalents.

Train Directory Report. This is a listing of all the trains currently in transit and the date on which they commenced their journey.

Repair Summary. By specifying a location (e.g. station, TMS area or district), a report by wagon class is provided on the number of wagons under repair.

Status Report. This is a report by wagon-type and status (inwards loaded, outwards loaded, empty, repair, in transit etc.) of the current number of wagons at any location.

In addition there are other reports

which can be obtained as daily summaries. These so-called batch reports include:

Waste Report. A waste day accrues to any wagon which remains at a location for more than eight hours without changing its status. The report summarises the number of waste days and status for each wagon at a location.

Uload Report. For a TMS area, this is a listing by station of the number of wagons which have accrued 1, 2, 3 or 4 or more waste days respectively. Used by District Management in conjunction with Status and Waste Reports.

Dload Report. A listing for any specified location of the wagons which have incurred more than 3 waste days.

Loaded Out Summary. A table of the number of each wagon-type waiting to leave each station in a TMS area.

Condemned Wagon Report. A listing of the condemned wagons at a station and how long they have been there.

Wagon Count. A listing of all wagons on each District Management Section, also total number on each island. The information includes total number of wagons by classification at stations, on shunts and on trains.

All the above reports are a reflection of the previous 24 hours (up to 1900 hours) and are freely available. There is no confidentiality in the system. (e.g. Area 1 can check on Area 2 etc.)



Number-takers, selected on the basis of education standard and capability, collate the initial input in relation to train and shunt movements. Foremen record status reports while guards provide details of wagons attached or detached at unattended stations.

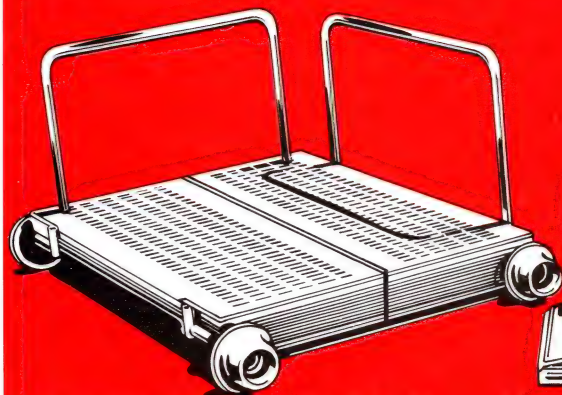
The extent of NZR's effort expended in training has resulted in accurate and reliable reporting of data to TMS centres, and the resulting success of the system has led to improvement of staff morale generally.

Average daily wagon loadings increased by 20 percent after TMS introduction, with a further 10 percent expected to be achievable with the full system implemented; original estimates forecast a minimum improvement of 8 percent in utilisation, based on experience with the Napier pilot scheme.

To be continued.

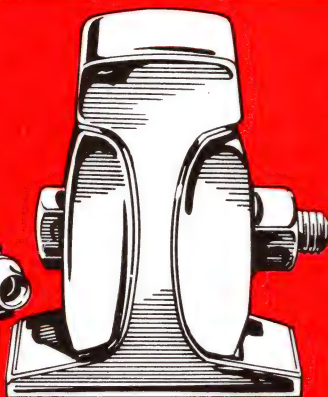


A TMS operator at her visual display unit has a magnificent view of the Te Rapa rail yard.



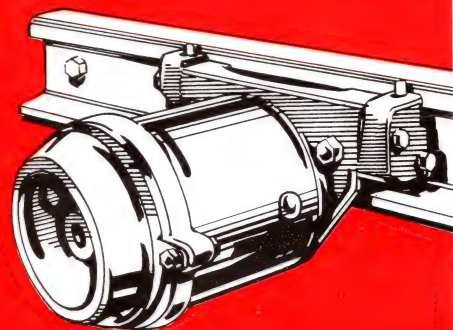
SAFETRAN PORTABLE TRACK CAR

This lightweight all-aluminium unit for all gauges is quickly assembled by one man. Transports loads of up to 3000 kg.



PORTEC BONDED RAIL JOINTS

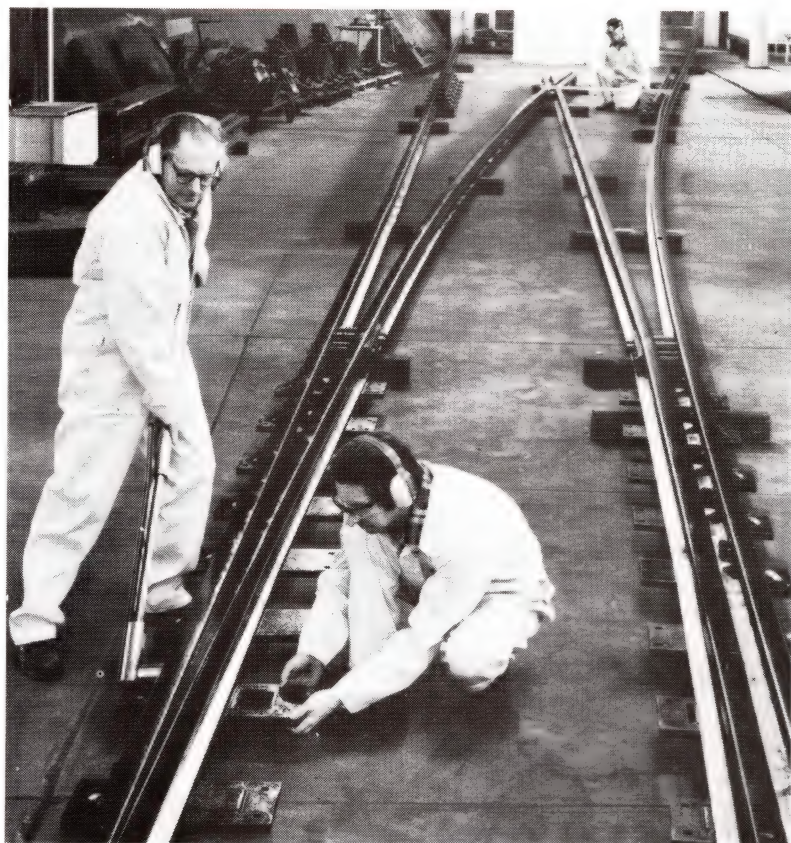
Provide extremely strong, permanent, maintenance-free joints. Manufactured in both straight and curved arrangements to State Rail specifications.



PORTEC CURVE LUBRICATOR

Wheel activated to deliver grease to side of rail head, where flanges distribute it to the running face for extended rail and wheel flange life.

Portec trackwork equipment shunts across to Thompsons-Byron Jackson.



For over 85 years, Thompsons-Byron Jackson have worked for most railways in Australia and New Zealand. We've supplied them with all necessary trackwork and accessories, and pioneered many technological advances.

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TG4088

Call it the Supertrain, the Red and Silver Bullet or just the XPT. With three major services now in operation, the State Rail Authority's pride and joy has revolutionised train travel in New South Wales.

Australia's first XPT went into service on the Sydney/Orange/Dubbo run on April 8, 1982, another XPT has been speeding between Sydney and Kempsey since May 31, and the latest addition to XPT routes was the Riverina as from August 23.

Holder of the Australian train speed record at 183kph, "Inter-City XPT" has slashed almost hours off the previous travelling times to the various final destinations it now serves.

The State Rail Authority ordered a total of 30 XPT units at a cost of about \$34 million and is now considering buying more.

Built by Commonwealth Engineering, (NSW) Pty. Ltd., the XPT is a complete departure from previous railway planning in Australia. Greater efficiency and lower overall operating costs is the philosophy behind the purchase.

The aerodynamic design of the XPT presents a visually different concept to other Australian trains. Because of this low profile, the train is able to maintain higher speeds on curves. It also has faster acceleration and braking. It does not, however, travel at maximum speed because of track limitations.

Designed for the future, the XPT will utilise track improvements as they occur. The train has a power unit at both ends, giving faster turnaround



'Home' for the inter-City XPTs — the \$6.25 million XPT maintenance centre at Meeks Road near Sydenham, NSW.

Travel times 'slashed'

time at its destination and less chance of being disabled by mechanical failure. Passengers note a smoother ride — a result of the air-suspension system. What do passengers find when they step aboard? The new train is more a reminder of an airliner.

There are reclining, aircraft-style seats, most with a table folding down from the seat in front. Other seats have fixed tables. There are individual overhead reading lights, aircraft-style toilets, automatic sliding doors and chilled water dispensers in each carriage. Carpet extends to window level, the windows being double-glazed and heat-reflective.

New maintenance facilities have been built near Sydenham for the XPT, at a cost of \$6.25 million. The effect of the

XPT introduction has been wide-ranging. Australian and overseas governments have been closely watching the performance of the new train and its improvements to country rail travel in New South Wales. The intake of XPT units has allowed older carriages to be taken out of service for modernisation.

The XPT trains and the modernisation programme are part of a capital investment for public transport involving more than \$1,400 million over the next five years. It includes completing the replacement of the suburban rail fleet with new double-decked carriages, more interurban carriages and new locomotives and freight wagons.

Suburban passengers can now enjoy the comfort of heated travel during cold wintry days with the introduction of the first heated cars on the Sydney suburban network.

The State Rail Authority of New South Wales now has in suburban service one fully air-conditioned double-decked train undergoing evaluation trials, and seven heated double-decked trains, each with 6 carriages, which provide warm and cosy travel for suburban passengers.

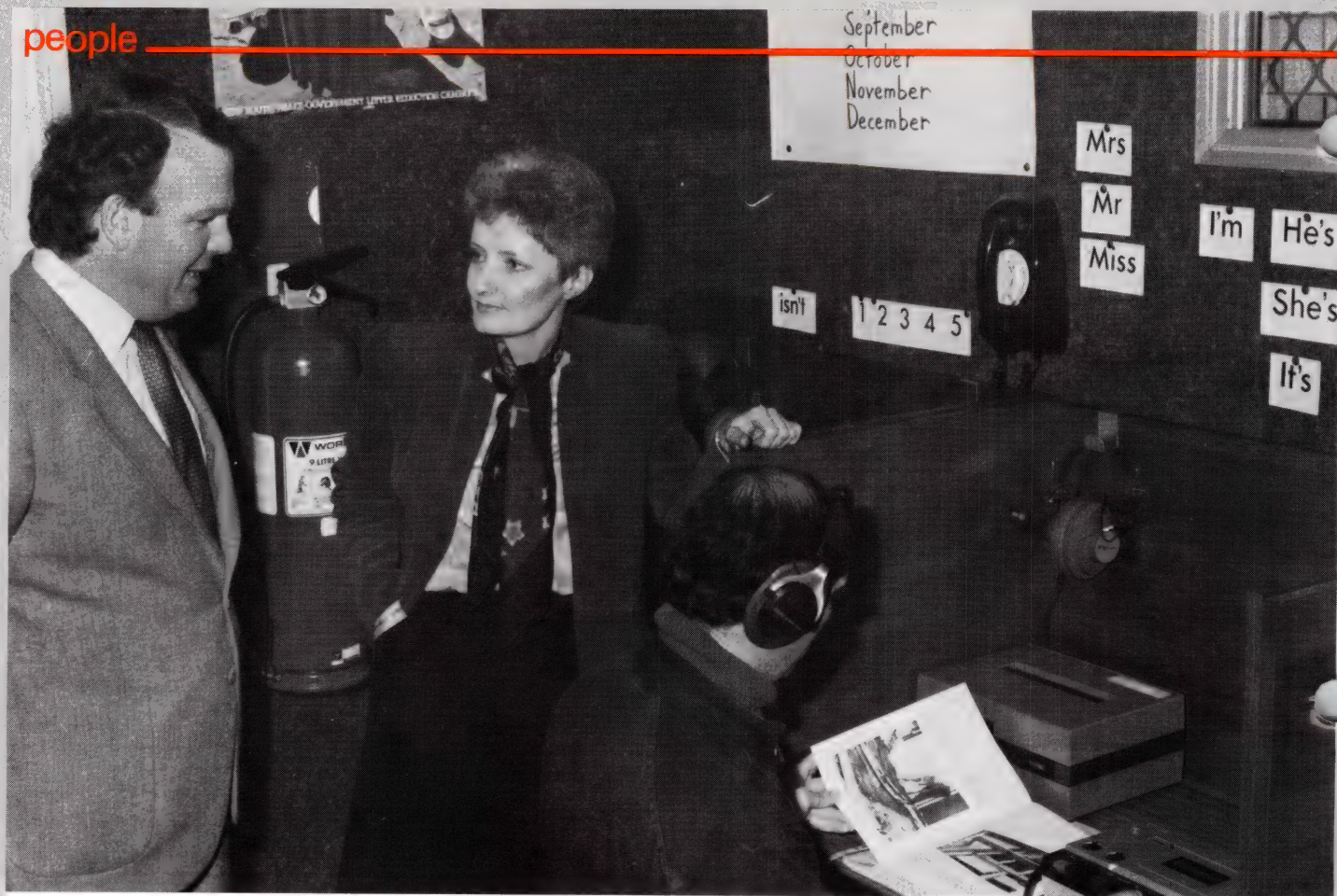
The heated carriages are being progressively delivered to the State Rail Authority by A. Goninan and Co., Newcastle. This rollingstock manufacturer is building 92 double-decked carriages for the State Rail Authority at a total cost of about \$52 million.

Forty-four carriages are already bringing added comfort for suburban passengers and the remaining 48 cars will be placed in service at the rate of four per month.

Heat's on . . . more comfort



One of the SRA's heated double-decked Suburban trains. Seven 6-car trains are currently in service with more to come.



Mr David Hill, SRA Chief Executive speaks to Joyce Hitchen, teacher from the Adult Migration Education Service at the opening of the Language Resource Centre.

Language Resource Centre 'a first'

The State Rail Authority's recently opened Language Resource Centre could well become the model for similar programmes in other Government Departments and in private industry.

The Centre is fully equipped to assist staff developing their skills in using English.

At Sydney's Eveleigh Air-Conditioned Train Depot, the special facility is available to 300 carriage cleaners, of whom 96 per cent are from a non-English speaking background.

The centre consists of a room fitted with extensive equipment for teaching English. An overhead projector, an audio-visual unit, tape recorders, headphones, reading and writing materials are used under the guidance of teachers from the Adult Migrant Education Service.

As a result of an investigation conducted last year by Arbitration Commissioner Graham Walker, it was suggested that English classes be conducted at the Depot.

The Centre cost \$45,000 and can accommodate up to 20 students at any one time. On opening day, 42 had enrolled in the classes which are held during working hours on both day and night shifts. At the new Centre, workers can have formal lessons, or use the materials to teach themselves.

English classes are held at a number of other SRA depots, but the Eveleigh Language Resource Centre is the most innovative example of the SRA's efforts to date in breaking down staff language barriers.

Psst! Want to buy a train?

At the State Rail Authority's Railway Shop in Sydney you can stop playing trains and start to own them! Located under Sydney Central Terminal at 488 Pitt Street, The Railway Shop was officially opened on June 27.

How about a nice early 1900s carriage for starters, some sleepers or a cast-iron spiral staircase from a signal box? If you are less ambitious, there's lamps, station signs, luggage racks, water bottles, door handles, dog spikes and other authentic items used during the 127 year history of the New South Wales Railways. There's even the carriage sink!

For customers who want more than souvenirs, there's things you can use, like typewriters or calculators and things you can wear — T-shirts, badges and railway ties. The Shop also sells framed photographs of steam locomotives, and inexpensive posters that can decorate a room, a bar or even a house.

Prior to the opening of The Railway Shop, railway memorabilia was only available to the few who knew of its existence and where to apply for their purchase. But now the shop has become a mecca for those wishing to acquire such items

as — old timetable sheets, Track Diagrams, Railway publications, Tie Bars and brooches, Railway Caps, Stickers, posters and postcards, Signal Quadrant blades, Level crossing signs, Guards hand lamps, Table kerosene lamps, Brass signal levers, Station name boards, Luggage racks, Locomotive plates and many other items, including diagrams for model makers.

The Railway Shop telephone (02) 219 1941 is open — Wednesdays to Fridays — 10.00am to 5.00pm; Saturdays and Sundays — 10.00am to 4.00pm.

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Today's rail freight is really on the move. Australia's rail freight network can be favourably compared with the world's leading railways. And we didn't get where we are today by copying everybody else.

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Cenwag, our Centralised Wagon Control System, is another local innovation. Cenwag effectively monitors all rolling-stock throughout Australia, and maximises

their use on a daily basis.

The very rolling-stock that Cenwag controls has also been affected by technology. With specially built wagons for bulk freight like steel, coal, grain, and produce.

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S.A. Australian National (Adelaide) Tel: (08) 267 4300. TAS. Australian National (Launceston) Tel: (003) 31 5211.
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WHYALLA ROLLING

"The Premier of South Australia, the Hon. David Tonkin, today performed the official opening of BHP's new \$40 million rail rolling and finishing facility."

The lead up to this headline started eighty one years ago when, on the 10th January 1901, a party of men stepped ashore on the western shore of Spencer Gulf in South Australia to commence construction of the Iron Knob Tramway.

In those days BHP was still a silver, lead and zinc producer. The company's interest in the ironstone deposits of the Middleback Ranges was for use as a flux in the smelting of the products from Broken Hill. The tramway was built to avoid the long and arduous haulage of ironstone by bullock cart to Port Augusta thence by rail through Pichi Richi pass to Quorn and ultimately to Port Pirie via Peterborough.

Construction of the tramway used rail imported from the U.S.A. Steel production in Australia was uneconomical at the turn of the century due to wheat ships backloading steel and iron as ballast for the empty return trip to South Australia. The link between Whyalla (or Hummock Hill as it then was) and the railway industry was forged in the first days of its establishment. The operation of the Iron Knob Tramway has made BHP at Whyalla a continued consumer of railway materials. The difference now is that Whyalla rolls its own.

The plunge into steelmaking undertaken by BHP in 1915 was based heavily on the production of rails for the booming railways of Australia. The first rolling mill built by BHP at Newcastle was primarily a rail mill, though by modern standards a small one. The manufacture of the heavier rail sizes was transferred to A.I.S. at Port Kembla in 1936. Only the lightest sections continued to be rolled at Newcastle.

The light rail production (22kg/m) was transferred to Whyalla from Newcastle in 1976. The rolling of heavier rails was first undertaken at Whyalla in 1977, when production of Australian Standard 60kg rail was begun using the calibre method to meet an order for long length rails for Westrail which could not be produced at Port Kembla. Shortly after, construction commenced on the facilities to universal roll rails at

Whyalla and to develop new rail finishing facilities which have just been opened.

A full appreciation of the modern technology being applied to rail manufacture at Whyalla requires a look at the plant which feeds raw steel to the rolling mill.

The soundness of the finished rail is established in the steel plant. The Basic Oxygen Steelmaking plant at Whyalla was established in the mid-sixties and is sufficiently modern to require no special modification for the production of rail steel. For this critical grade, scrap and hot metal are selected so as to minimise later problems — dirty or wet scrap is not used.

Steel from the furnace is tapped into a ladle and then into ingot moulds. Rail steels are very susceptible to a form of cracking called "flaking" as a result of entrapped hydrogen. In order to avoid this a "low hydrogen practice" has been established and is strictly monitored.

Hydrogen can enter the steel from any source of moisture. It is thus clear that all ladles, moulds and other items coming into contact with the steel must be and are kept absolutely dry. The steel when poured into ingots is "fully killed", that is agents are added to the steel to completely absorb all oxygen remaining in the steel from the steelmaking process. Fully killing results in higher losses in the later cropping of blooms, but this penalty is accepted. It achieves a higher standard of consistency in the steel than has previously been available using "semi-killed" steels in which some free oxygen is left in the steel.

Primary rolling. The ingots are rolled to blooms which are treated to ensure that any hydrogen which may have been absorbed is dissipated. The blooms are charged to a cooling box at a temperature of 500-700°C and covered so as to cool them very slowly. They do not reach 200°C for about 24 hours, which allows any hydrogen to diffuse out of the blooms.

The still-warm blooms are removed from the cooling boxes and surface defects are removed by descaling torch as required.

The universal rolling process.

Rails have traditionally been rolled by the calibre method. This technique uses a series of roll pairs in which the rail is rolled by progressively changing



its shape from a rectangular bloom to that of the finished rail.

The bloom is first broken down to a rough top hat shape. It is further worked by the pairs of rolls into which calibre or grooves have been machined. The section is reduced in thickness in progressive passes through the rolls but the width of the section, which becomes the height of the rail, remains unchanged.

This method is a conventional rolling technique used throughout the world to produce bars, rounds, hexagons, angles, channels and many other shapes. The technique has limitations, especially when applied to rails however, in that unlike all the other sections described the main service load on rails is a contact load applied on what is the side of the section as it is rolled. The sides of a bar being rolled are only lightly forged and thus do not obtain their best available strength. In addition the rotation of the rolls causes surface scratching of the head and base of the rail just where it is most preferable to avoid these marks. The scoring also results in heavy roll wear and ultimately increases the cost of the rail.

Wear of the rolls causes the shape and size of the rail being produced to vary during the course of a rolling and finally when the acceptable tolerances are reached the rolls must be remachined. In order to keep the cost of this machinery to a minimum manufacturers aim to make full use of the tolerances which will be accepted by customers.

The universal rolling method is fundamentally different. The bloom is broken down to a smaller size by pairs of rolls as in the calibre method but the

By David

ROLLS ITS OWN



from the Universal Mill on which they are rolled. The lions share of the capital expenditure required to launch full scale production of rails at Whyalla however, was absorbed by the establishment of a rail finishing plant.

The task of the rolling mill is complete when it supplies rail lengths to the finishing plant. At this stage the production process is far from complete; The rail still requires cooling, straightening, inspecting, repairing of minor defects and allocating to a customer. This process is highly automated.

The rail enters the finishing plant by being pushed onto a cooling bed. This operation also bends the rail through a gentle arc so that as it cools, the uneven contraction resulting from the difference between the head and foot thickness leaves a rail which is very nearly straight by the time it is cold. Once cool, the rail is straightened in a roller straightener. This device bends the rail up and down in apparently alarming manner to the extent that it is surprising to the uninitiated to see a straight rail emerging from the exit of the machine.

Since the mill is required to roll many products other than rails a large surge stockpile is located at this stage of processing. The stockpile absorbs rails during the four to six shifts per week that rails are being rolled and feeds back into the process the rest of the time.

From the stockpile, rails are put back into the process line. The rail is dried as it passes through a hot air oven and has all loose mill scale brushed off. This enables the inspection process which is next in line to be performed more easily and very accurately.

Inspection is undertaken by four inspectors. These people are housed in an air conditioned, well lit room. The rail enters the room through an entry and is scrutinised on all sides. The bottom of the rail is viewed in a mirror to obviate the need to turn the rail. The sides and top are simultaneously inspected, one inspector for each face, as the rail slowly crosses the room and departs through another hole in the opposite wall.

Should the inspectors detect any surface defects, the offending section of the rail is marked by crayon, and a red marker is attached to a master inspection label which is applied to the

rail during its transit of the inspection station. Rails which satisfy the inspectors receive a green sticker to indicate acceptability.

On emerging from the inspection station the rail is flooded with water. The object is not to wash the rail but to provide adequate coupling between the surface of the rail and a series of ultrasonic inspection probes. These probes send sound waves into the rail and listen for echoes. The probe system used, and its associated computing system, is capable of finding defects in the interior of the rail which are beyond the eye of an inspector.

This innovation has added a margin of safety from internal defects in the rail previously unknown in Australia, and as yet applied in few locations in the rest of the world; France, Japan, Sweden and the U.K.

The monitoring of the section being rolled is performed by the mill and is a guide to any adjustments which may be necessary. In order to provide assured quality, however, both ends of every bar are checked for conformity with the tolerances laid down in standards agreed with the customer. The ends of the rail as cut by the hot saw are generally sufficiently square and smooth to permit welding. The hot saw cannot, however, deliver a consistent length after the rail has cooled. This limitation led to the installation of a milling saw which coupled with its associated measuring system, permits the supply of rails with very clean ends, completely free of any saw rag and cut to a close length tolerance. The same machinery installation also drills the rails for use on bolted track if the customer requests it. The ends of the rails, or any other part should it be required, are straightened in the Four Way Press. This machine is capable of applying a bending force on the rail in any of the four directions — up, down or either side without the need to rotate the rail. The advantage of this system is speed and minimum handling damage.

After this multitude of inspections and checks it is inevitable some unsatisfactory rails will be found. These are either scrapped or corrected. Some may have small surface flaws ground out, others which are not straight may require a detour to the Four Way Press. Whatever the treatment, a steady

main shaping operation is conducted in a universal rolling stand. The universal stand uses two horizontal rolls to form the web and in addition two vertical rolls form the top of the rail head and the base of the rail. A further pair of horizontal rolls on a closely linked stand forms the toes of the rail, sides of the head and the gauge corners. The forging action applied to the rail head in this stand refines the metal grains and results in a higher quality rail. Most of the forming is achieved in one universal roll set, or stand, but it is completed by one pass through a finishing stand.

Secondary rolling. The significance of the Universal Mill has already been described. Before the bloom can be rolled, however, it must first be reheated. This is done in a gas fired furnace which raises the temperature of the rail bloom to about 1100°C. On removal from the furnace the bloom is broken down to a smaller section on two conventional two roll stands before coming to grips with the universal stands. On completion of the rolling, the rail section has grown to a length of about 90m. This is cut to manageable 27m lengths by a "hot saw" which cuts through the rail in a matter of seconds. Such samples as are required for testing and checking of accuracy of the rolled section are also removed at this point. The lengths of rail leave the mill at this stage as they pass through a stamping machine. This permanently brands every individual piece to identify its exact position from an ingot, the position of the ingot in the pouring sequence and the ladle of steel from which the rail was made.

The rail finishing plant. The name of the rail rolling plant has been taken



stream of finished prime quality rails emerges from the end of the system. Bearing in mind that one of the major advantages of siting the rail plant at Whyalla was the availability of cooling facilities capable of handling 27m lengths, the advantage would be lost if these long rails could not be delivered to the customer.

It is at this point that Whyalla's earlier railway history has provided an advantage. A rail link was established in 1972 by the then Commonwealth Railways (now Australian National) with a siding into the BHP works.

This has now been connected to the rail finishing plant so that long rails can be loaded directly on to the user systems' own rail trucks. The long lengths are beyond the capacity of existing rolling stock so are currently loaded onto married pairs, each with a single end bulkhead and side posts to prevent movement of the load.

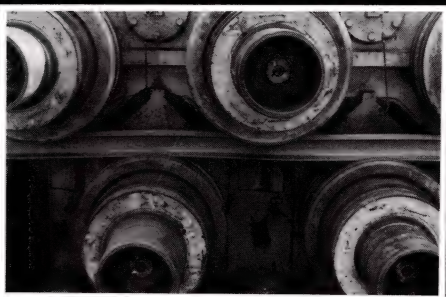
The next few months will see the progressive transfer of all rail rolling operations to the Whyalla Universal Mill from the Port Kembla mill. In addition, the 60kg rail section which had been rolled at Whyalla using calibre rolling methods will also be rescheduled as a universal section.

Over the past two years, development and construction has been taking place on a head hardening facility. The strength and wear resistance of all rails will be greatly increased by heat treating the head of the rail. A two stage electrical induction heater will heat the rail to about 900°C, after which air blasts will cool it quickly to achieve a stronger, tougher metallurgical structure. There is, of course, a considerable price penalty for this treatment but the improved performance is attractive to many heavy haulage railways.

The Whyalla rail plant was built in order to satisfy the Australian Railways' demand for higher quality rails in longer lengths than could be produced on old plant. That this is not the only outlet for a good product has already been demonstrated by the shipment of



The Premier of South Australia Mr David Tonkin officially opens the new rail rolling and finishing facilities as BHP Chairman Sir James McNeill (centre) and Whyalla General Manager Mr Bob Chadban look on.



A rail passes through the roller straightener at the new rail finishing end.

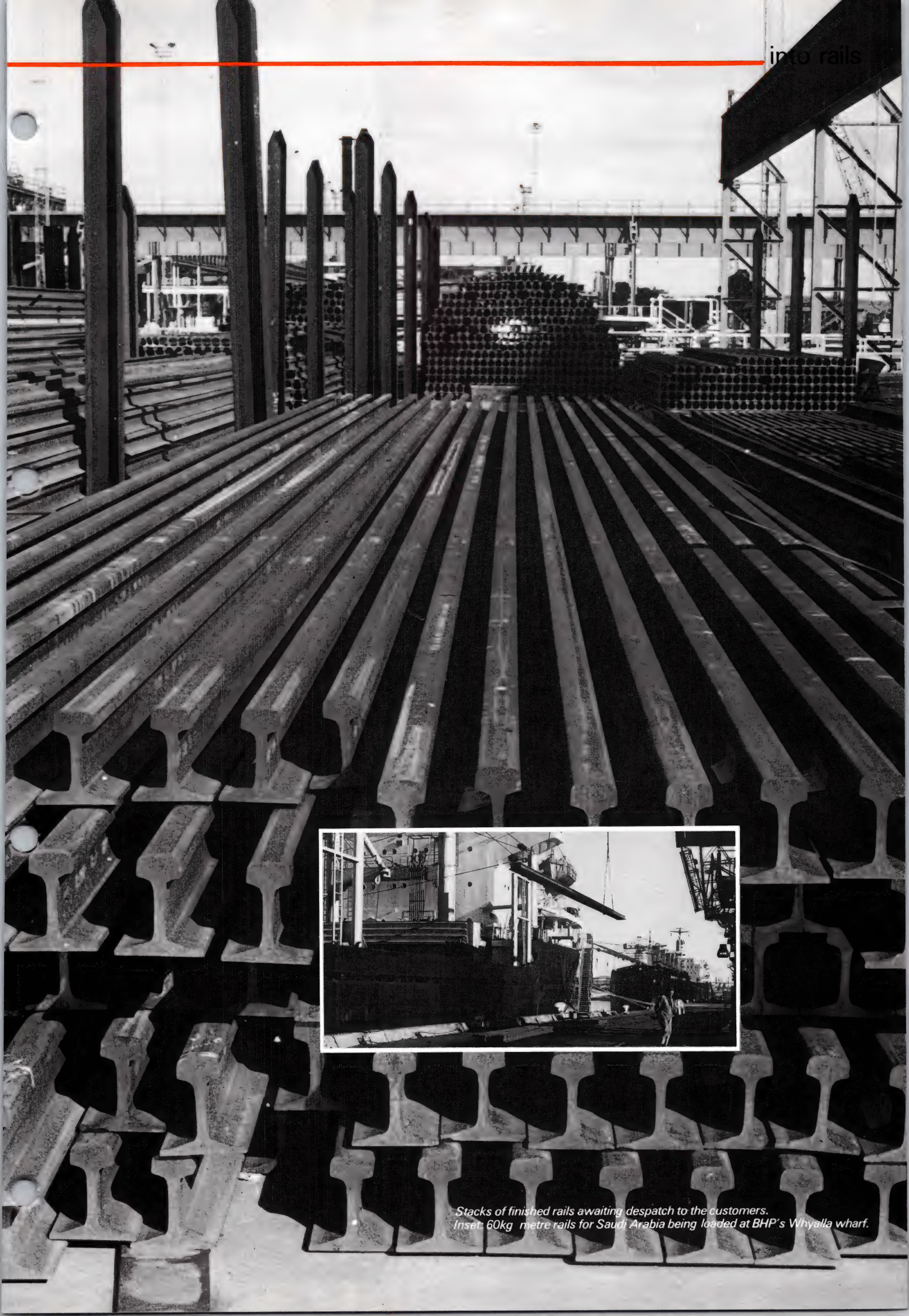
10,000 tonnes of rails to U.I.C. 60kg section to Saudi Arabia. A second shipment for the same order is currently in production. Enquiries for other overseas customers are always



being sought and prospects appear to be limited only by the currently depressed state of the world economy.



The rails are visually inspected for surface quality at the primary inspection station before being ultrasonically tested for internal defects.



*Stacks of finished rails awaiting despatch to the customers.
Inset: 60kg metre rails for Saudi Arabia being loaded at BHP's Whyalla wharf.*

An escape to warmer climes

Brisbane has yet to stir from its day-of-rest slumber when at 8.10am each Sunday, from April through September, a two-car rail motor leaves the empty platforms of Roma Street station on a five-day journey which traces the 1,770 kilometres of narrow gauge to Cairns, in Queensland's Far North.

On each departure over 80 passengers, who board in pairs as if beckoned by Noah, are bound for the tropics on the Daylight Railcar, a leisurely, unpretentious tour along Queensland's Sunshine Route.

The response to The Daylight Railcar tour has taken both Queensland Railways and the Queensland Tourist and Travel Corporation, who jointly package the tour, by surprise. In 1981, 2,757 tourists used the DRC package as their escape route to Queensland's warmer climes. By July 1982, 2,850 sunseekers had followed the "Sunshine Route", smashing the previous year's record with two months to spare.

The popularity of the DRC is firmly based on the relative cheapness of the tour (the package includes all meals and accommodation en route) and the chance it affords the traveller to see a vast stretch of Australia unhurried.

There are various packages which incorporate the Railcar Sector, one of the most popular being the 15-day Sunstate Rail Special.

The northbound Sunstate, for instance, commences with the five-day DRC sector from Brisbane to Cairns, stopping overnight at Maryborough, Rockhampton, Mackay and Townsville. Passengers occupy the best accommodation each centre has to offer on a twin share basis.

The railcar belongs entirely to its passengers. Photo stops are made at such places as the Glasshouse Mountains in the heart of pineapple country on the Sunshine Coast (fruit salad is served here) and at the Burdekin River, which separates the twin towns of Ayr and Home Hill, about 90 kilometres south of Townsville.

There are nightlights tours of Townsville and Cairns; a coach tour from Maryborough to Hervey Bay and the holiday resorts of Pinalba, Scarness, Torquay and Urangan; a tour of bustling Gladstone followed by lunch;

a city sights tour of Australia's "Sugar Capital", Mackay; lunch at Bowen is followed by a tour of the town's bays and sandy beaches; and a luncheon cruise from Lucinda to Cardwell through the beautiful Hinchinbrook Passage.

All the while the railcar waits in readiness to commence each leg, scarping along the narrow gauge at between 80-95 kph, while either the driver or guard uses the public address to point out places of interest and to offer a smattering of history to boot.

The Sunstate Special includes seven nights in Cairns, with twin share accommodation on a breakfast only basis. The Good Old Fashioned Aussie Banquet at the Mountain Groves Restaurant (this is followed by an unforgettable spotlight tour through the tropical rainforests in an army duck) and lunch on Green Island during a day cruise to the coral cay, are included in the package.

Other activities in Cairns and its environs include coach tours of the northern city and its attractions; a stop at Australian Bird Park en route to Port Douglas and Mossman Gorge; the scenic rail journey through Barron Gorge and past the spectacular Stoney Creek Falls to Kuranda; an afternoon cruise on Lake Barrine, on the Atherton Tableland; and a tour of the Nerada Tea Plantation, nestled at the foot of Queensland's highest mountain, Mt Bartle Frere.

It's back on the rails for the return trip to Brisbane. The Sunstate Special includes an overnight journey in a first class sleeping berth aboard the Sunlander.

The 15-day Sunstate Rail Special allows you to either commence or end your holiday with the seven nights in Cairns. The southbound Sunstate commences with the overnight trip on the Sunlander from Brisbane to Cairns, returning a week later on the Daylight Railcar, substituting Bundaberg for Maryborough as an overnight stop. The 1983 DRC series will feature 44 departures, an increase of 10, from late April to late September.

For bookings and information contact the Queensland Government Tourist Bureau or the Government Railways in each State.



Above: The Hinchinbrook Passage cruise on which passengers enjoy a delightful lunch on the route from Lucinda to Cardwell.



Above: The Glasshouse Mountains. Right and below right: Passengers board the 2-car rail motor "which belongs entirely to its passengers" for the duration of their tour.



'air express'

'Zero altitude flight'



As of Spring '82 Lufthansa, the German airline will offer all the comforts of flight at "zero altitude" through the Rhine Valley. Lufthansa introduced its unique Airport Express earlier this year. Four times daily, streamlined express trains travel between Frankfurt's Rhine/Main Airport and Dusseldorf, Cologne and Bonn. The trains offer travellers from the State of North Rhine-Westphalia an alternative to the regular feeder flights operated between Frankfurt and Dusseldorf and Cologne/Bonn (these cities are served by one airport). The project is at present planned to last one year, with the aim of this co-operation between Lufthansa and the Bundesbahn (Federal German Railways) being to determine whether there is sufficient interest in this alternate service.

Painted in Lufthansa colours, the "train to the plane" transports 127 passengers in two cars fitted with conventional express train compartments and one car with a

"widebody look" interior. In addition, there is a special car with seating for 36, where drinks and cocktail snacks are served.

It is possible to use the Airport Express only with a valid flight ticket; no tickets are sold at the railway stations or aboard the train. When they make their bookings, passengers decide whether they wish to fly as usual, or use the Lufthansa train. In special cases, or in the event of last-minute ticket purchases it is possible to use the train providing space is available. The Bundesbahn has chartered three trains to Lufthansa (the type is known in Germany as the ET 403), and is providing the engine drivers. Passenger handling and on-board service is provided by Lufthansa personnel . . . thus ensuring the comforts of flight at "zero altitude". Depending on time of day, an ample breakfast, or cold lunch or dinner is offered. Passengers are served, as aboard aircraft, at their seats. There is a full selection of complimentary non-alcoholic and

alcoholic drinks.

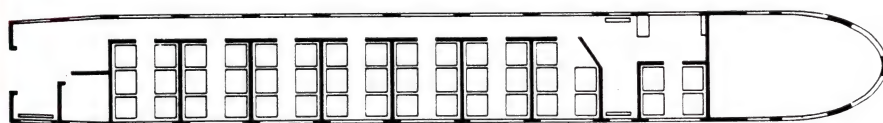
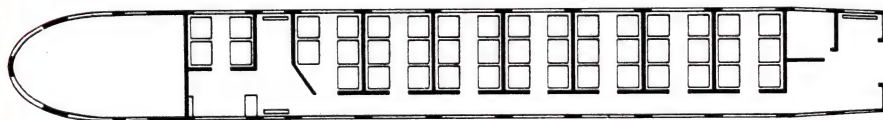
The Airport Express travels at up to 160 km/h through some of the most beautiful landscape in Germany . . . through the Rhine Valley with its Drachenfels, the Lorelei, picturesque cities and castle ruins. Those who tire of the scenery will find a complete assortment of German and international newspapers and magazines. The refreshment car is also available at all times during each trip.

During the trip to Frankfurt, baggage is made ready for the aircraft. When the train reaches Frankfurt Airport, passengers need only take their luggage from the train and place it on a waiting cart. From there, they can go to their respective check-in counters; their baggage is placed automatically aboard the aircraft. Travellers going from Frankfurt to Dusseldorf, Cologne or Bonn receive their baggage at a special location on the platform . . . there, they pass through customs and onto the Lufthansa Airport Express.

says Lufthansa

The special train service is an experiment to determine whether there is sufficient interest in train travel as a supplement to normal feeder flights between Frankfurt and the three other cities. Should the experiment prove there is sufficient demand, aircraft now used on these routes might be replaced by smaller, more economical types. The Lufthansa Airport Express trains can be used by anyone holding a flight ticket for Dusseldorf-Frankfurt, Frankfurt-Cologne/Bonn, or Frankfurt-Dusseldorf; passengers must only state when making their booking whether they wish to fly or travel by Lufthansa Airport Express. It makes no difference which airline is used for international flights into or out of Frankfurt, however, the total journey must begin, or end, in Dusseldorf or Cologne/Bonn (the latter two cities are served by one airport).

Passengers will be able to use their flight ticket for the train whenever it is more convenient to do so, or when there is no longer space available on the flight most suitable to their schedule. In this case, there is no difference in fare between travelling by air or by train.



Two motor coaches with a total of 77 seats



One open-plan car with 45 seats



A dining car. It serves passengers as a lounge with bar service, or simply as a pleasant ambience for talks and business contacts. These seats are not available for sale.

Each coach is equipped with a separate galley.

Technical Data

Designation	ET 403/404
Max. Speed	160km/h (on suitable tracks)
Length overall	109.22m
Seats	122
Add. lounge seats	36
Length of end-cars	27.45m
Length of centre-cars	27.16m
Distance between bogey pivot	19m
Width of carriage	2.795m
Height of floor above rail	1.3m
Bogeyes	2 bogeyes, air suspension
Distance between bogey axles	2.6m
Wheel diameter	1.05m
Smallest turning radius	120m
Operating weight	ca. 235.7 t
Mean loading per bogey	147kn
Power plant	4 (one per car)
Drive motors	4 x 4 = 16
Drive Type	AC/DC motors
Cooling	Self cooling
Transformers	4 each with following individual outputs Drive power 1000kVA Airconditioning 100kVA Subsidiary services 75kVA Coil Cooled
Control	Thyristor-gating control with 2 semi-controlled rectifier bridges in sequential control per car. Field intensity control.
Rated power of drive motors at 139km/h and effective field ratio of 81%	16 x 240kW = 3.840kW
Continuous power per motor	350A
Max. starting current per motor	550A
Max. braking current per motor	650A
Max. voltage at startup	750V
Min. effective field ratio	41%
Max. starting power of drive train at 110km/h	6.000kW
Max. braking power at 160km/h	10.400kW
Braking distance at 160km/h	ca. 1.000m
Air conditioning plant per car	Air thru put 2.000m³/h Heating 43kW Cooling 23kW
Crew	2 Drivers 2 Check-in Stewards 4 Service Stewards

Train spotter's nightmare.



Despite its made-yesterday appearance, this GM diesel locomotive is actually 17 years old. It's proof of how complete a Clyde rebuild really is.

The underframe has been sandblasted and modified to take the modernised replacement parts. All wiring, piping and cables have been replaced. The latest engine, crankcase and power assembly have been exchanged for the old ones, ensuring spare parts availability for years to come. The traction motors have been completely overhauled. The

generator has been fully reconditioned. The cab layout has been modernised to the latest standards. And a new low profile nose has been fitted to greatly improve visibility. There's a whole lot more, all adding up to another 15-20 years of locomotive life. All for about half the price of a new locomotive. And a bit of confusion for the more observant train spotter.

Call us for more information, and we'll show you just how much you will actually save.



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Above: Passengers can enjoy a drink in the lounge car of the Lufthansa Airport Express. Below: The express travels through some of the most beautiful scenery in Germany — the Rhine Valley. Inset: The driver's view from the "Cockpit".



By Sandra Bardwell

In the later decades of the 19th century many Australians attached great importance to the physical and spiritual refreshment afforded by vigorous exercise in the outdoors. By 1894, when the oldest surviving bushwalking club in Australia, the Melbourne Amateur Walking and Touring Club was founded, walking for pleasure had been a popular pastime for many years.

Men strode energetically through the bush seeking relief from the noise and fumes of the city and women often accompanied them, regardless of their voluminous, flowing skirts and large hats.

At the turn of the century, summer Sunday trains were well patronised by Melbournians bound for the lush coolness of Ferntree Gully in the Dandenong Ranges. From Upper Ferntree Gully station, visitors stepped almost directly into the depths of a fern gully, many bound for the summit of One Tree Hill, a commanding vantage point for views of Port Phillip Bay and the plains stretching towards the city.

The opening of the Baw Baw Tourist Track early in 1907 by the State Governor Sir Reginald Talbot, introduced an exciting challenge for adventurous Victorian walkers. Linking the small town of Warburton on the Upper Yarra River and the famous gold mining centre of Walhalla near the Thomson River, the 80 km long track crossed the beautiful sub-alpine Baw Baw Plateau. Once the narrow gauge railway from Moe (on the main Gippsland line) to Walhalla was completed in 1912, the Tourist Track was accessible by rail at both ends, there being a railway from Melbourne to Warburton. Over the next three decades, many thousands of walkers made the journey across the Baw Baws, until the cessation of the rail service to Walhalla and the closure of the catchment of the upper Yarra Dam effectively abolished the Tourist Track.

Australia's first National Park, the Royal National Park about 30km south of Sydney, was established in 1879. Only seven years later the Illawarra railway reached the Park, and National Park station on a short branch line was opened. This development brought the hitherto isolated beaches, inlets and forest tracks of the Park within easy reach of Sydneysiders and the number of visitors increased steadily.

RAILWAYS



Blue Mountains National Park New South Wales.

BUSHWALK

Today, walking tracks start at National Park, Engadine, Heathcote and Waterfall stations. These and many other tracks in "The Royal" have long served as an initiation ground for bushwalkers from Sydney. During the early 1930s bushwalking, a term coined in 1929 by the founders of the Sydney Bush Walkers Club, enjoyed a tremendous boom. New clubs were formed, maps were published to meet the special needs of walkers and in Sydney, walkers campaigned successfully for the protection of Blue Gum forest, one of their most treasured haunts. The Victorian Railways vigorously promoted the pastime in co-operation with Melbourne newspapers. "Mystery Hikes", starting from railway stations, were organised and articles describing walks and giving advice to novices were published regularly. Under the leadership of Harold Clapp, the Victorian Railways fostered the State's infant tourist industry. In 1924, the Chalet in the heart of Mt Buffalo National Park — a walkers' paradise — was taken over by the Railways and has remained under its management ever since. Throughout the 1930s the Victorian Railways also conducted a guesthouse at Hotham

Heights, on the roof of Victoria in the north-eastern alps — walking country par excellence.

For the adventurous and energetic, tours were conducted to a bungalow on Mt Feathertop, not far from Hotham Heights, under the guidance of a Railways officer, the Snow Line Representative. Sadly, the devastating bushfires of January 1939 consumed the buildings at Hotham Heights and Feathertop and only the former was rebuilt.

For many years the railway was the only means of transport from the cities to the uninhabited bush where walkers truly explored the more remote areas of Gippsland in eastern Victoria and the Blue Mountains in New South Wales. Inherent in many of these walks which used train travel was a freedom which use of the motor car does not easily confer — the freedom to start and finish a walk at two widely separated points. A classic example of this flexibility was the popular traverse of eastern Victoria, from Tallangatta close to the Murray River, to Bairnsdale on the eastern coast, via the mountain town of Omeo.

During the 1950s dependence on rail transport by the Australian community in general and no less by

AND

ING

bushwalkers began to decrease as motor car ownership became more common.

Nonetheless, when this writer began her bushwalking career as a youthful member of the Sydney Bush Walkers in 1962, train timetables were as familiar to members as were maps of favourite walking areas.

Memories are still very clear of the Friday night rendezvous on bustling Central Station, of the journey on the "Fish" to Katoomba, eating huge sandwiches and watching regular travellers engrossed in their nightly games of cards and draughts.

Another well loved journey was on the southern highlands line, still steam in the 1960s. Tallong, between Moss Vale and Goulburn, was the usual station from which the return journey was made. As it was a request stop only, someone was posted to listen for the approaching train while others crowded into the lone shop to buy their evening meals to eat on the train. In summer, split-second timing was vital: out of the shop clutching a billyful of peaches and ice cream and straight onto the train!

The camaraderie of rail travel, its homely comforts, the absence of worry and tension and the opportunity to enjoy the passing

scenery were recalled with vivid clarity during recent walking holidays in England. At Oxenholme on the main line linking London and Glasgow, along with many travellers whose boots and rucksacks marked them as dedicated walkers, we spilled onto the platform to change for the local train to Windermere, in the Lakes District, one of Britain's most popular walking areas.

Being a country of vast distances and relatively small population, Australia cannot support a rail network as convenient as that in Britain. Yet, there are some excellent walking areas throughout Australia which are served directly by rail or by rail and a connecting bus operated by the rail authority.

In view of the increasing likelihood of more leisure time being available and as crowded roads and high costs make driving less attractive, the merits of rail travel in conjunction with bushwalking deserve to be more widely promoted and recognised. Bushwalking is undoubtedly one of the faster growing leisure time activities in Australia.

Its values as a non-competitive, outdoor recreation which can be adapted to all ages and levels of physical capacity, its particular suitability for families, the challenges it offers to resourcefulness and self-reliance, and the skills to be acquired, are being enjoyed by growing numbers of people.

Rail transport is more practicable for journeys to and from extended walking holidays than for weekend excursions when flexibility in times of arrival at and departure from the start of a walk is of the essence. For a holiday, the very factor of distance which by car travel represents a drawback is a distinct advantage for the train traveller. The rail journey is an integral part of the holiday, to be enjoyed in its own right. It is not a chore to be completed as quickly as possible, as is often the case with a long car drive.

In recommending some ideas for railway-bushwalking holidays, the intention is not to give details of individual timetables, but to draw attention to services within the States concerned and to the opportunities for walking at the end of the rail journeys. In order to give an Australia-wide coverage in the space available, only one venue in each State is described. There are, of course, many more potential venues for railway-bushwalking holidays throughout the country.

It is assumed that walkers would travel from their home State by the appropriate interstate service. Details of timetables and fares may be obtained from railway interstate booking offices, tourist bureau and travel agents.

New South Wales. Almost every station Glenbrook and Clarence on the main western line from Sydney can serve as the starting point of a walking holiday in the Blue Mountains National Park. From early morning until late in the evening on weekdays there is an hourly or better service at least as far as Katoomba, the "capital" of the Blue Mountains. On Saturdays and Sundays, trains are less frequent, being spaced up to two hours apart.

Occupying a vast area of 208,000 ha, the National Park embraces the trackless Wollangambe Wilderness, the spectacular Grose Valley with sheer sandstone walls, the pools and beaches of Glenbrook Creek, and the plateaux extending southwards from near Katoomba. The Park also includes a large tract of mountainous country within the Warragamba catchment surrounding Lake Burragorang, one of Sydney's major water storages.

In the popular and readily accessible parts of the Park, many walking tracks lead to the outstanding scenic attractions. Elsewhere, walkers need to be self-contained and proficient in bushwalking skills. It would not be difficult to devise a varied and interesting itinerary for a ten day walking tour in this National Park. Visitors should familiarise themselves beforehand with the regulations governing use of the Park (see list of addresses below).

Northern Territory. There could scarcely be a more exciting approach to the Macdonnell Ranges in central Australia than by the New Ghan. After nearly ten hours' travel from Taroona on the Trans-continental line, across the empty interior of South Australia and the southern Northern Territory, a thin line appears above the northern horizon.

It gradually develops into a formidable mountainous barrier which seems to block the way northwards. As if by magic, a passage opens and the long sinuous Ghan emerges through Heavitree Gap to roll in dignified style over the last few kilometres to Alice Springs station.

Here the connection with the railway must, for the time being, be severed and a vehicle hired to venture further

afield, unless the motorail service has been utilised.

Alice Springs is situated in the centre of the Macdonnell Ranges, an intricate line of mountains, ridges, hills, chasms and intermittent watercourses, extending for more than 120km both east and west from the town.

It would take half a lifetime to exhaust the multitude of opportunities which the Ranges have to offer for bushwalkers. National Parks and Nature Reserves managed by the Conservation Commission of the Northern Territory provide convenient bases from which to become acquainted with many of the more spectacular features of the Ranges. Two of these reserves exemplify the many-faceted appeal of the Macdonnells. Trepghina Gorge Nature Park, almost 100km east of Alice Springs, is a place in which to find peace and quiet and subtle beauty on a modest rather than an awesome scale. In the western Macdonnells, the Ormiston Gorge and Pound National Park has scenery of a spectacular order: the soaring, red-orange walls of the Gorge, the huge amphitheatre which is the Pound, over which the massive bulk of Mt Giles, the third highest peak in the Ranges (1295m), broods in shadowy silence.

Queensland. Unfortunately the writer has been unable to identify any major bushwalking areas in Queensland which are directly accessible by rail. There are however, short to medium length walking tracks on several of the Great Barrier Reef Islands which are National Parks, although most walkers would cover each Island in a day or two. One solution would be to "island-hop" on a combined walking, swimming and fishing holiday, visiting the Island National Parks listed below. Each town on the mainland from which water transport leaves for the islands is served by The Sunlander which departs Brisbane's Roma Street station Mondays to Saturdays. From Maryborough: Great Sandy National Park on Fraser Island; from Mackay: Brampton and Lindeman Islands National Parks; from Townsville: Magnetic Island National Park and Hinchinbrook Island National Park (for which it is necessary to catch a bus from Townsville to Cardwell); from Tully: Dunk Island National Park; from Cairns: Green Island National Park.

(continued on page 34)



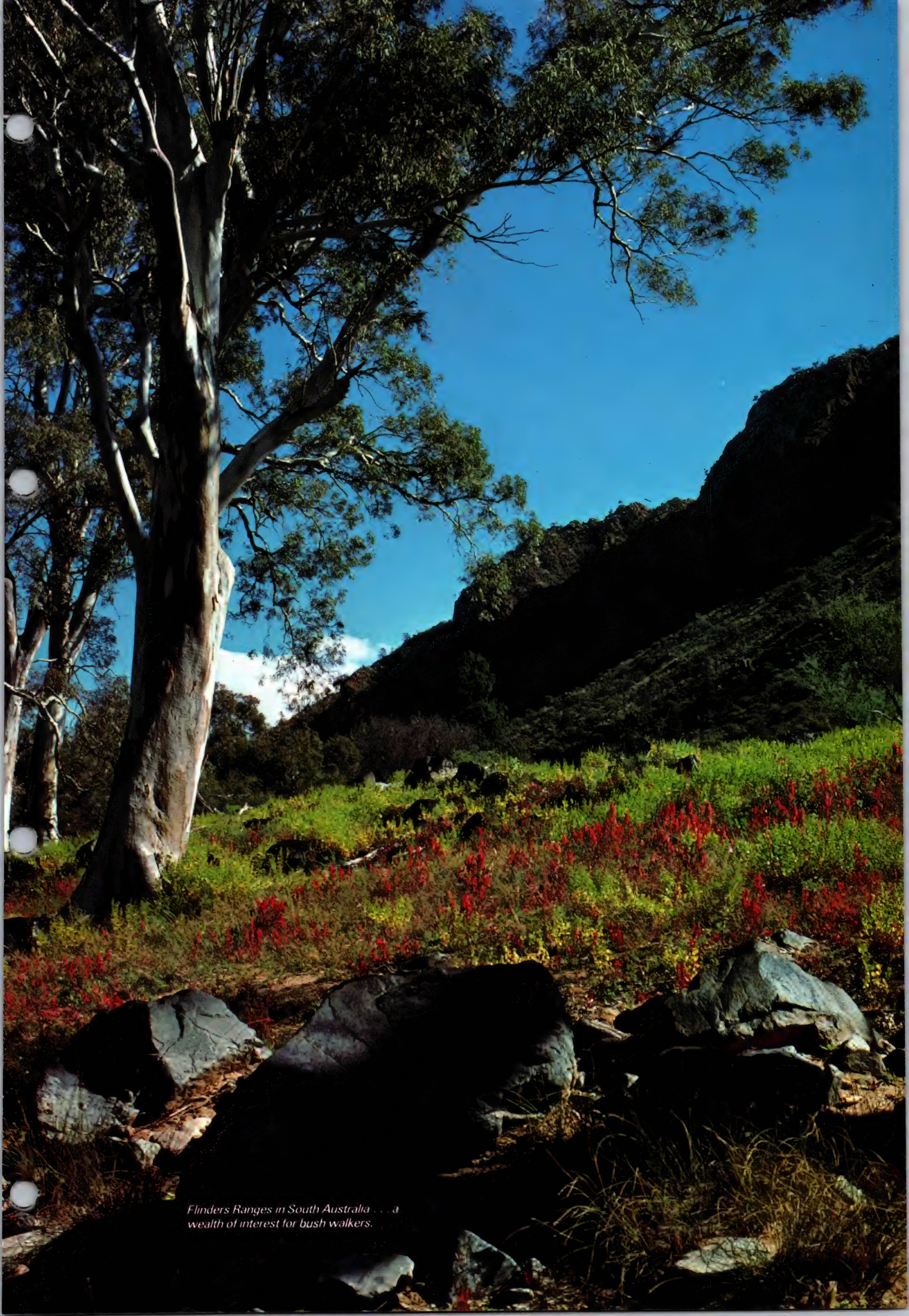
The Ghan southbound emerging from Heavitree Gap on its journey from Alice Springs to Adelaide.



Scenic route between Upper Ferntree Gully and Belgrave, Victoria.



Dunk Island . . . one of the many 'Island hops' possible for the bushwalker in Queensland.



*Flinders Ranges in South Australia . . . a
wealth of interest for bush walkers.*

(continued from page 32)

South Australia. South Australia's semi-arid Flinders Ranges are of great interest to bushwalkers in that they provide a very different type of experience from that found in the mountains and forests elsewhere in Australia.

To reach the Flinders Ranges National Park by public transport it is necessary to catch a mixed train which usually leaves Port Augusta for Leigh Creek and beyond on Thursday evenings and arrives at Brachina station early the next morning. The return train stops at Brachina on Saturday afternoons. Intending travellers should bear in mind that times of departure on this service are flexible and may be altered at short notice.

From Brachina, it is a half day's walk across the plains to Aroona Valley, in the heart of the Flinders Ranges. At the head of this valley stands St Marys Peak, at 1200m the highest point in the Ranges. Beyond it is Wilpena Pound, a huge natural amphitheatre ringed by towering red cliffs. At least a week could be spent in the Park, visiting the many peaks, gorges and lookouts. There is a large campsite at Wilpena and bush camping is permitted at other sites with the advice of the Park Ranger (see list of addresses below).

Victoria. Mt Buffalo is one of Victoria's oldest National Parks, and the Chalet standing within sight of the rim of the spectacular Buffalo Gorge, is one of Victorian Railways' most successful and enduring enterprises. Opened in 1910, the Chalet was taken over from a private lessee by the Railways Refreshment Service in 1924, at the behest of the Chief Commissioner of Railways, Mr (later Sir) Harold Clapp.

Under his guidance, the building was renovated and extended and the Wangaratta-Bright train timetable was reorganised to better suit Chalet patrons.

Within the National Park, encompassing the sub-alpine plateau of which Mt Buffalo is the highest point (1723m), is some of the finest mountain scenery in Victoria. Gently undulating grassy snow plains threaded by tiny streams, a host of rocky peaks and huge, free-standing granite boulders, are all within reach of the Chalet. Many of the paths which are part of the extensive network of well-made, clearly defined walking tracks in the Park, may be

joined almost at the front doorstep. A daily rail and bus service conveys passengers from Melbourne to the Chalet. It is advisable to make reservations well in advance for peak periods: Christmas-New Year, Easter, and May school holidays. During the winter, Mt Buffalo National Park is usually snow covered and very popular with alpine and cross country skiers.

Western Australia. The Bibbulmun Track in south-west Western Australia is one of the best but least known long distance walking tracks in Australia. Developed and maintained by the State Forests Department, it is 505km long, thus offering 20 to 30 consecutive days' walking.

Named after a distinct aboriginal group who formerly inhabited the south-west, the Track links Kalamunda, 25km east of Perth and the Boorara Tree, a giant Karri near Northcliffe, far to the south. It traverses a variety of landscapes, embracing the best scenery in that part of the State: majestic jarrah forests on the extensive plateau country, steep sided river valleys, Karri forests and former agricultural land.

The larger part of the Track follows rarely used forest tracks. Elsewhere it has been designed to pass through areas of bushland. Several shorter circular tracks, linked to the main Track, may be included in the full length walk or completed independently.

As it passes through at least two towns (Kirup and Pemberton) which are served by the State Government's Westrail trains or buses, the Track may be followed for only part of the full distance. Three towns on the circuit tracks (Collie, Noggerup and Balingup) are similarly served. Indispensable to planning a walk along the Bibbulman Track is the guide book published by the Forests Department (see list of addresses below).

Kalamunda is served by several Metropolitan Passenger Transport Trust bus routes. The return journey from Northcliffe can be made in one of three ways. A Westrail bus service operates direct to Perth twice weekly. Alternatively, Westrail buses depart from Northcliffe once a week for Albany on the south coast, and for Bunbury on the west coast. An overnight stay in both towns is necessary before the connection can be made with the train to Perth.

Rail Bookings.

For reservations in each capital city:

New South Wales
Travel and Tours Centre,
State Rail Authority of
New South Wales
or Sydney Terminal Station
11-31 York Street,
Sydney 2000.
Tel. 217 8812
Telex AA25702

South Australia
Australian National
Interstate Booking Office
Railway Station
North Terrace
Adelaide 5000
(G.P.O. Box 1743)
Tel. 212 6699
Telex AA82829

Victoria
Interstate Booking Office
Spencer Street Station
Melbourne 3000
Tel. 62 0771
Telex AA31927

Queensland
City Booking Office
Queensland Railways
202 Adelaide Street
Brisbane 4000
Tel. 225 0211
Telex AA41514

Western Australia
Interstate Booking Office
Westrail Centre
Perth 6000
(G.P.O. S1422)
Tel. 326 2811
Telex AA92460

Tasmania
Tasmanian Tourist Bureau
80 Elizabeth Street
Hobart 7000
Tel. 34 6911
Telex AA58017

Bringing trees to a treeless plain

Merv Weston flicked through the pile of neatly stacked papers on his desk. It was only yesterday that he had seen that paper he was looking for. The one about some new equipment for a children's playground, the beginnings of which he saw from his office strategically placed in the middle of the tiny railway town of Cook.

Once he'd found the note, Merv would send it off on the next morning's train to Australian National's Welfare Department in Port Augusta where the request for bright new swings and seesaws for the town's 39 children could be arranged.

Cook is basically Merv's town. And his duties as Roadmaster 1132km away from Australian National's centre of operations in Adelaide and smack in the middle of Australia's world famous Nullarbor Plain, can include anything from supervising 300km of track on the Trans-Australian Railway to gently sorting out a scuffle between a couple of young pre-schoolers. He even has the power to apprehend offenders in the town. It's somewhat reminiscent of a lone sheriff in one of the American wild west towns of old.

But that's the way railway settlements such as Cook have always been run, since they were first established around 1912 for fettlers working on the construction of the east-west line.

After completion of the rail link across the country, these construction gangs were disbanded, but a series of camps were maintained to house the fettlers working the line and the station staff and train crews involved in traffic operations. Cook was one of these.

But it's not that looking after the younger ones troubles Merv. After all, in his job, based in various railway communities along the 1690km of line between Port Augusta and Kalgoorlie, he's had plenty of dealings with them. And to Merv, and the other Australian National employees living at Cook, children are what life is all about. That's why when the silvery coaches of the Trans-Australian passenger train pulled into the town on a deceptively fine day for the month of July, there was plenty of excitement.

The entire school, which had been granted a public holiday, were out in force to greet the train along with AN staff. On it were five members of an organisation called Men of the Trees whom Australian National had brought out there for the seemingly impossible task of planting 600 trees which hopefully would survive in one of the

most inhospitable environments in the world. But there was another reason for the air of excitement at the station besides the arrival of Men of the Trees. An ABC television crew had also made the journey to film a segment on the tree planting exercise for

"Countrywide", a weekly program which covers events in rural areas.

The tree planting proposal had been greeted with mixed reactions back in Adelaide. Some thought that any organisation which hoped to change the name of the plain which in the language of Aborigines means "no trees", had perhaps spent one too many days in the relentless Australian sun. But the people of Cook thought otherwise. To them it would someday mean a more pleasant environment for their children.

While in the past Education Department teachers and an Australian National station master named Tony Dippel had successfully established some trees for welcome shade in the town where summer temperatures soar to over 50°C, the more trees the better according to the Australian National staff based at Cook. With Cook being the only stop between Port Augusta in South Australia and Kalgoorlie in the West, it would eventually mean a more pleasant stop over for passengers. In fact, those travellers who had met representatives from Men of the Trees and Australian National on the train were only too willing to jump off board to plant a tree for posterity. The passengers, who had been informed of the exercise as the ABC would be stopping the train at intervals to film along the way, were highly interested in the project, enthusiastically standing by to watch the activities of the ABC and the group on board.

At Cook, the group were met by five members of the Men of the Trees Western Australian branch, if you will excuse the pun. The day then began with a talk to the community by the SA Organiser of the Men of the Trees, Malcolm Campbell, who explained the necessity of planting trees for shade, erosion control and shelter.

He also pointed out the historic significance of the occasion which marked his organisation's 60th anniversary. He told the crowd that since its founding in Keyna by a highly respected environmentalist, Dr Richard St Barbe Baker, the Men of the Trees had gained the support of such

notables as the Prince of Wales who happens to be the organisation's patron. The Cook tree planting exercise was also Australian National's contribution to the International Year of the Tree, which officially got underway in June.

A highly amusing demonstration of how the holes for the trees were dug followed the speechmaking. With the ground in the region having absolutely no top soil whatsoever, Australian National staff had spent some days beforehand with a jackhammer, drilling through the earth to loosen it enough for dirt to be scooped out. Once all this had been explained, the children were divided into groups, assigned a task leader and sent out to happily spend the day attempting to beautify their environment.

The group of approximately 60 people managed to plant some 450 trees during the day. Those who were not actively involved in planting worked on the sidelines, preparing food for the tree planters, or just being on hand to transport people around the town. The saplings which were not planted during the day, or taken home by the townspeople for their own gardens, were left to be established by two members of Men of the Trees who stayed on an extra day to give lessons on plant propagation to the children at the school.

All this was surveyed with great pleasure by Merv who considered that many of the trees would have a good chance of survival. While he acknowledged that the planting of trees at Cook will not do much to change the ecosystem of the Nullarbor, he recognised it was not the point of the exercise. He considered the tree planting to be a valuable community exercise and he has already organised a roster for 2 weekly watering of the saplings which will include children, teachers, AN staff and other government workers in the town.

"Though many people wonder how we survive being in such an isolated part of Australia, there always seems to be plenty to do. Through our own fund-raising activities and the assistance of Australian National we now have a licensed community club, new tennis courts — and there's always the visitors who come to Cook to perform", the roadmaster said referring to the performing arts groups which AN sponsor from time to time to entertain the communities along the line.



Introducing the SUM 1000 Track Laying Machine



Fourteen years ago, Plasser & Theurer first introduced the concept of the fully automated track relaying train to European railways. Since then, a total of some 9,000 km. of new track has been laid or relaid by Plasser equipment worldwide.

The SUM 1000 is the latest product of Plasser's unmatched experience in this field. The first totally automated track construction machine to be built in Australia, the SUM 1000 recently completed construction of the Muswellbrook-Ulan railway project.



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PL012/FP

A major step for safety

VicRail has taken a major step to enhance passenger and crew safety and improve operating performance with the installation of a two-way radio system in suburban trains.

In the first stage, 55 six-carriage trains, which can be operated as three-car units in off-peak periods have been equipped with radios. They have been installed in the drivers and guards compartments of each motor 'M' car.

VicRail plan to operate services after the evening peak period using trains equipped with radios. The new system enables police or other emergency services to be summoned quickly to assist train passengers and crews.

Drivers and guards are able to report such incidents to Area and Line Controllers at Metrol, nerve centre of VicRail's suburban train operations.

This advice enables the controllers to better co-ordinate train running throughout the suburban network.

To enable reception over the metropolitan system, a series of nine base stations have been established.

Five of the base stations serve the surface network. These are located in the city and at Broadmeadows, Doncaster, Mt Waverley and Frankston.

As radio waves cannot penetrate underground, a system had to be devised to provide continuous radio reception for trains travelling through the underground City Loop.

This problem was solved by placing a radiating cable in each of the four tunnels. These cables can be regarded as a series of small aerials from which waves radiate along the entire cable length.

This gives an effect as though radio waves were being leaked from the cable's outer sheath. These cables are commonly regarded as "leaky co-axial cables".

The upper and lower levels of the City Loop have been divided into two

sections. They start at the Western and Eastern portals and meet at Museum station. Four base stations service these underground tunnels.

Controllers at Metrol can select which base station they want to send their message through. They can choose one, several or all base stations.

In the field, one or more base stations may receive the message submitted by the driver or guard.

Each base station relays the message by landline to Metrol along with a further message sent by the base station, describing the quality of the signal. High-speed electronic circuits at Metrol compare the "quality of transmission" of each signal.

The base station with the clearest signal automatically switches in and all further conversations between Metrol and crew-member is conducted through that base station.

New deal for country passengers

VicRail's "New Deal for Country Passengers" introduced last October, has changed the whole concept of Intra-state train travel. Now it looks certain to bring about the demise of another railway tradition — the famous railway meat pie.

For decades the staple meal of train travellers, the "pie-n-sauce" was a notable omission from the menu of the prototype BRN Buffet Car when introduced to the public for the first time.

When the first of the buffet cars enters regular service in October, travellers will be able to select their meal from a variety of dishes. The menu includes beef stroganoff, lasagna, hot rolls, salads and hamburgers.

And like the meat pie, another familiar item is missing this time behind the counter of the buffet cars — the pie warmer. For the train travellers of the eighties, food will be cooked in microwave ovens.

Even where you eat your meal will change. Passengers will take purchased items back to their seats in cardboard containers which have provision for hot drink cups.

So, no longer will you sit and watch the world go by as you eat your meal in the buffet car.

The prototype buffet car was constructed as part of the seventh set of N Cars at VicRail's Newport Workshops. It went on public trial

during the busy May school holiday period.

To enable VicRail staff and their families to sample the new facilities, the seventh set operated special excursions between Melbourne and Bendigo during the first week of the holidays.

These new catering arrangements are another feature of VicRail's upgrading of country passenger services. On train catering will be a feature of all InterCity services by late 1983.

Each of the 18 N Car sets will have a buffet car as part of their consist.

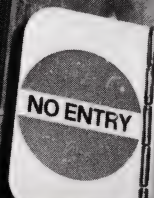
Seating for 67 economy-class passengers is also provided in the BRN car.



New buffet facilities, another feature of VicRail's "New deal for Country Passengers".



*Radiating cables placed in all four tunnels of the City Loop relay messages to underground trains.
Inset: Left — Voice log recorder tapes dialogue between controllers and crew. Right — Guard Alec Crusiz operating his two-way radio.*





A section of the Hamersley Iron Railway between Dampier and Tom Price Mine, Western Australia

McKAY SAFELOK LOCKS IN POSITIVELY

McKay Safelok retains track geometry under adverse conditions.

More severe operating conditions than those to which McKay Safelok has been exposed are difficult to imagine—sharp curves down to 200 metre radius (8.5°), axle loads of 32 tonne (36 U.S. Ton) and temperatures ranging from minus 36°C to plus 43°C . McKay Safelok is designed to cope with these extremes, maintain toe loads, prevent sleeper slewing, and is doing it well.

Safelok for extended track life, reduced operating costs.

Safelok has successfully passed tests: By Professor J. Eisenmann at Munich Technical University, Germany, and A.R.E.A. fastener tests conducted by A.A.R. Research Laboratory, Chicago, U.S.A.

A significant advance on proven and acceptable fasteners, the system consists of a shoulder, pad, clip and insulator. Safelok extends

track life with positive and lasting track alignment.

High creep resistance An exclusive feature is "Creeplok"—a secondary locking device which increases creep resistance to 12kN-16kN (2700lb-3600lb) per rail seat, ensuring track stability and reduced sleeper slew under the harshest conditions.

Largest deflection range Minimum safe deflection 8mm. Maximum safe deflection 17mm; giving a 9mm working deflection range.

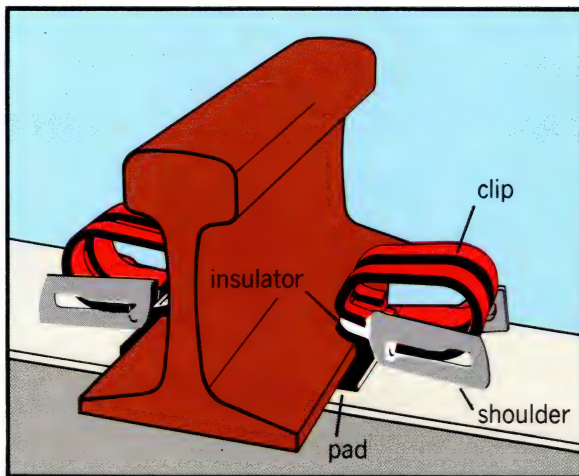
High hold-down force Rated at 18kN (4000lb) nominal, normal in service range is 16kN-22kN (3600lb-4950lb).

Positive locking Quickly locked into position, clips cannot work loose, because the two clip legs lock sideways after passing through a gate in the shoulder.

For complete information, please contact:

McKay Components
(A division of Ralph McKay Ltd.)

36-46 Hampstead Road,
Maidstone, Victoria,
Australia. 3012.
Telephone:
(03) 317 8961;
Telex: AA31538





Repeater station at Muswellbrook, part of the Broadmeadow to Werris Creek radio relay system for the State Rail Authority of N.S.W. The system was supplied and installed by Plessey Australia.

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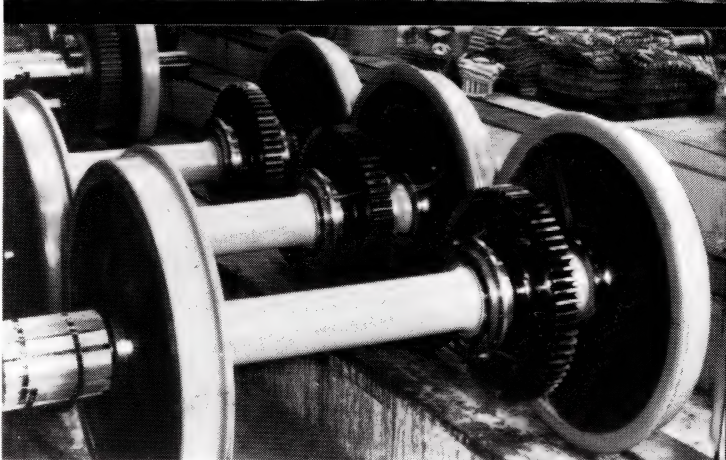


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PT78

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Development of bogies for XPT

Track conditions

Wheel and rail profiles. The lateral ride predictions identified a substantial degree of sensitivity to the effective wheel to rail conicity. The State Rail Authority standard wheel profile has a 1 in 20 coned tread face which provides a low initial conicity, but the shape is greatly modified with wear. The fully worn wheel conicity was unknown, although there was some evidence that it increased to about 0.15 (Coxon and McNaughton).

The P8 tread profile used on British Rail passenger stock does not change greatly with wear and bogies are designed to work with the moderate effective conicities that are obtained with this so-called worn profile on British Rail track. This tread profile was used on the wheels fitted to the prototype suburban CT22 bogies, and whilst the bogie remained stable against hunting at the maximum possible test speed of 120 km/hr, this profile clearly did not match New South Wales rails. Contact occurred in three distinct bands, giving two point contact at two different lateral displacements. In order to accurately define operating conditions, precise measurements of rail profiles were required. It was anticipated that this information would also assist in the development of a new tread profile that would be fully compatible with the rail head contour, and would therefore, wear reasonably evenly. This new profile would most probably be similar in some respects to the worn tread shape of standard cone profiled wheels, consequently, precise details of wheel profiles would prove to be most useful.

The wheel and rail profile measurements were made by a team from the British Rail Research and Development Division, Derby. Wheel measurements were made at Redfern in the air-conditioned train depot. Rail measurements were made on straights and curves both in and out of the metropolitan area.

The design of power and trailer bogies for the State Rail Authority's ultra modern XPT passenger trains presented COMENG with substantial engineering problems in meeting operating parameters of the new high speed vehicles on Australian track not specifically constructed for this purpose.

In the first article Network published on the matter in the last issue, COMENG Assistant Engineering Manager (NSW) and Member of the Institution of Engineers of Australia, Colin F. G. Butcher, examined some of the studies undertaken on the subject. Herewith is his second article in a three-part series.

The wheel measurements showed no sign of hollow wear regardless of time in service. This may be due to the frequent use of tread brakes on the steep down gradients on all main routes into Sydney but is also probably related to the high rate of flange wear which limits wheel life and so prevents hollow wear from developing.

The rail measurements showed a number of sites were tight on gauge ranging from 1430 to 1438mm in the unloaded condition. There was little evidence of side wear on the gauge face of the rails.

The wheel profiles were found to conform with the worn head profile as expected. The effective conicity ranged from 0.05 with new wheels (1 in 20 coned profile), up to 0.15 after about 18 months' service, by which time the flange wear limit had been reached.

The effective conicity with the P8 profile was assessed to reach about 0.5 on some test sites, regardless of whether the BR 1362 or NSW 1359mm back to back dimension was used to determine the wheel position on the rails.

A new tread profile was ultimately developed to suit New South Wales rail shapes. The effective conicity may be as high as 0.2 on some rails, but generally will be fairly low. This new profile should not wear rapidly as the contact stress falls as the wheel is displaced from a central position. Increasing the flangeway by 8mm reduces contact stress by about 13%,

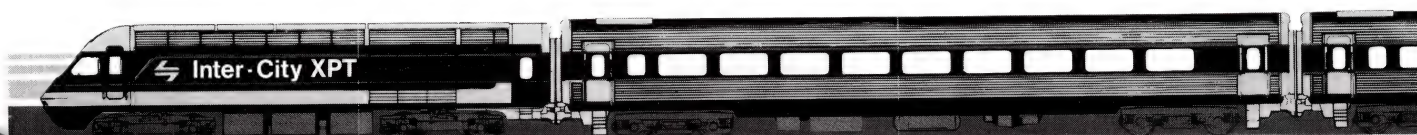
whereas a 6.5mm displacement towards the rail causes a 35% reduction. In the centralised position the contact stress is similar to a coned profile.

Track roughness. The State Rail Authority track maintenance standards for mainline track are very similar to British Rail track standards for the same maximum speed of operation, but the track recording chart sections supplied for the coarse assessment of the BT10 bogie performance clearly indicated a difference in overall roughness and characteristic wavelength. The State Rail Authority use an EM80 track recording car to measure the rail longitudinal profile and obtain a single track quality parameter, known as the track condition index, TC1. This index is the sum of three times the standard deviations for gauge, twist, top and alignment. Analysis of a large number of recordings for various lines indicates that the vertical and lateral roughnesses may be calculated from the TC1 with reasonable accuracy. The three standard deviation values are given by the following formulae:

$$\begin{aligned} \text{TOP} &= 0.27(\text{TC1}) + 0.55 \\ \text{ALIGN} &= 0.27(\text{TC1}) + 1.79 \end{aligned}$$

The track roughness on the British Rail system is also determined by statistical analysis of the longitudinal profile to obtain the standard deviations for the top surface and the alignment. The two systems of measurement both contain error due to their respective transfer

(continued on page 45)



SPRINGS FOR RAILWAY ROLLING STOCK.



*Fast freight bogie with Pioneer Springs and Wear Plates
as supplied to the New South Wales Public Transport Commission.*



Pioneer supplies springs and wear plates for the fast freight bogies and locomotive suspension units that are used to transport goods and passengers over mainline tracks at speeds up to 125 km/hr. Pioneer's reputation for reliability has spread all over the world. Transport engineers everywhere rely on the consistent high quality of Pioneer springs for suspension units.

PIONEER SPRING COMPANY



*The Southern Aurora, Sydney-Melbourne Express,
fitted with springs supplied by Pioneer.*

PN023.FP

(continued from page 43)

functions, with the EM80 offset chord method being particularly sensitive to the input wavelength. The results may be directly compared by converting one set of data using the ratio of the system transfer functions. This procedure was used to obtain State Rail Authority track data in a form suitable for input to the British Rail bogie performance simulation programme. In the following list the roughness standard deviations, in mm, are all 90% confidence limits for each sample. The Main South Line data is for the flatter section from Harden to Albury and this is not included in the data for all other routes.

TRACK	TOP	ALIGN
BR 160-200km/hr	2.5	2.0
BR80-120km/hr	3.0	2.5
SRA Main South	4.9	3.0
SRA All other routes	6.5	4.9

The vertical roughness usually has a characteristic wavelength related to the rail length, but the State Rail Authority have used a variety of rail lengths over the years. These different lengths are clearly identified by the PSD for a representative one kilometre section of track. The complex waveform shows that the subgrade contains considerable "memory" of past rail joint locations.

The alignment roughness may originate from vehicle roll induced by staggered rail joints, or from bogie hunting. The alignment PSD showed a single characteristic wavelength of 14.5m, which is equal to the hunting wavelength of a short wheelbase freight bogie with an effective conicity of about 0.15. Vehicles fitted with bogies of this type dominate the traffic pattern on all non-metropolitan routes. At high speed the input from long wavelengths originating from the small meanderings of track maintenance machines, can become a problem (Hill). The EM80 measuring system is not sensitive to wavelengths above about 20m and so the presence of long wavelengths in State Rail Authority track remains in doubt.

The cyclic inputs are generally most important in determining the vehicle ride quality, but the fatigue environment of the primary suspension and the traction drive system of powered vehicles, is more dependent on the frequency and size of the discrete defects or dips in the rail top surface. The shape of these dips is particularly important. The vertical profile records were sorted according to size and the number in each group was divided by the track sample length to obtain a distance based dip population. The dip shape was determined by measuring a large number of chart recordings of major dips. These were re-produced with expanded vertical and compressed longitudinal scales. The subtended angle between rail ends at joints was found to be reasonably proportional to the dip depth.

Curves and speeds. The high speed potential of the British Rail HST has been maximised by easing most curves that otherwise could not have been taken at full speed. This is not possible in New South Wales where the mountainous nature of the eastern part prevented construction of straight or gently curving tracks on the main routes radiating from Sydney. The straights are generally short, accounting for less than 50% of the distance on most XPT routes, and curves are only 240m radius on some mainlines. The Main South Line has some long relatively straight sections but in the 876km between the extremes of the Sydney and Melbourne suburban networks over 23% is curved at a radius of 1000m or less and in the 77km section between Campbelltown and Mittagong, 42% is at or below 1000m radius and almost 30% is at or below 400m radius.

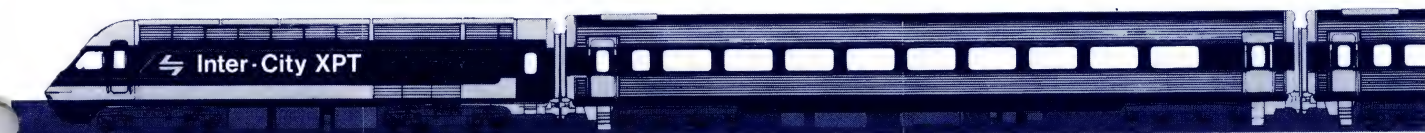
In many places the tight curves are on severe gradients which limit the speed of freight trains. The track cant cannot be increased significantly to allow

higher passenger train speeds as the cant excess for the slower freight trains would then be above the acceptable limit. The State Rail Authority currently set passenger train speeds for a cant deficiency of 75mm, but if the British Rail limit of 110mm is adopted for XPT, the speed on curves could be increased slightly depending on the individual circumstances.

The frequent speed restrictions for curves will prevent XPT from maintaining high speed for a large proportion of the distance on most routes. Even after taking into account the possibility of increasing speeds on curves, the distance covered at high speed will not be great.

Bogie trials. The British Rail computer predictions for the standard BT10 bogie on British Rail track gave good correlation with test results, thus the method could be considered to be proven. The models do, however, ignore inputs due to rail cross level differences and whilst this may be acceptable for British Rail track, some doubt was expressed that this was acceptable in making performance predictions for New South Wales conditions. As time constraints eliminated the possibility of making a set of XPT bogies, two standard BT10 bogies were flown to Australia for testing on representative New South Wales track. The prototype suburban CT22 bogies were modified to give suspension characteristics close to those used in the performance predictions for the modified BT10 bogies.

The wheel and rail profile studies had confirmed that the British Rail P8 profile was not compatible with New South Wales track, but a new profile had not been developed. In any case it would have been difficult to make wheel lathe templates and cut new profiles at short notice, and so all wheels were recut to the State Rail Authority standard coned profile. The bogies were fitted under



Railway Report.

Advertisement

From Australian Timken Proprietary Limited

No. 13 September 1982

Research brings results

The Timken "AP" (All Purpose) tapered roller bearing is undergoing a continuous research programme to ensure that it can handle ever increasing mass transit system demands.

The self contained, preadjusted, prelubricated, double cup sealed bearing unit is already in use in many urban transit systems throughout the world.

In Australia many suburban and inter city passenger trains have benefited from The Timken Company's stringent research and development programme.

Ongoing research at The Timken Company Research Centres in Canton, Ohio and Dunston, England assure the most advanced thought in bearing technology.

Since The Timken Company makes bearing steels as well as manufacturing tapered roller bearings, basic research is being done in both areas.

Full-size railroad bearing fatigue test machines at Canton are capable of testing up to and including the 177.8mm (7") Class G "AP" bearing.

There are three such machines, each with two shafts which test four bearings under elevated speed and loading conditions to accelerate the fatigue evaluation.

Even so, each shaft with its four bearings must be run 24 hours a day for two to six weeks to determine fatigue life characteristics.

Fatigue research in the laboratory under identical environmental conditions was also done on the effect of oil viscosity as shown in Table 1.

Table 1 "AP" Bearing Fatigue Research	
SAE Oil Grade	Life Index
20	1.00
5	0.45
50	2.12

SAE 20 oil is the standard fatigue test lubricant adopted to stimulate the film thickness obtained with AAR greases running under average conditions.

When using SAE 5, which has lower viscosity, the life is less than half of standard.

It can be seen that when SAE 50 oil was used, the life was more than doubled.

Although this indicates that high viscosity oil is beneficial to bearing fatigue life, variations in environmental conditions in the field must also be considered for optimum bearing performance.

This has been borne out by field tests undertaken since the first Timken "AP" bearing was introduced in 1954.

There are currently eight sizes of "AP" bearings with inch dimensions ranging from 101.6mm (4") to 177.8mm (7") bore and two metric sizes for UIC service having 120mm (4.72") and 130mm (5.12") bores.

A range of "SP" (Special-Purpose) bearings in four bore sizes, 120mm (4.72"), 130mm (5.12"), 140mm (5.51"), and 150mm (5.90"), has been developed based on the "AP" bearings but narrower in width.

The versatility of the Timken "AP" bearing is remarkably illustrated in the wide range of primary suspension designs for which it is suitable — for example, the Budd and Rockwell trucks have Timken "AP" bearing equipped inboard journals.

The primary suspension feature of these trucks consists of a rubber wraparound interposed between the "AP" bearing cup and the cast steel truck frame, with half cap arrangement allowing the wheel sets to be dropped.

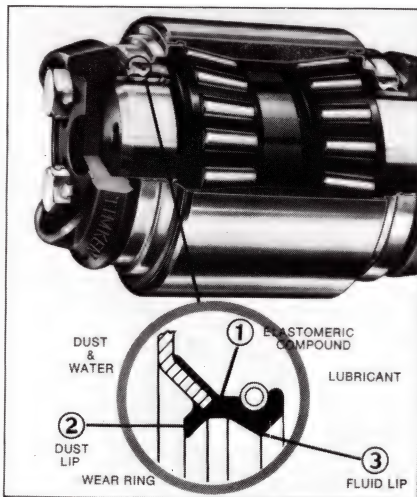
Other designs of primary suspensions developed in Europe and using "AP" bearings include symmetrically arranged rubber springs (Clough), metal chevron suspension and radial arm suspension with coil springs split in the area of the "AP" bearing to allow wheel set removal.

The cross-braced truck is now under development to improve wheel set performance and the self-contained "AP" bearing can readily be accommodated in this newly developed design.

These journal box roller bearings applications were originally oil lubricated but were changed over to grease lubrication around 1946.

After the change over the relubrication period was established first at a 1-year cycle, then extended to 18 months, and then 2 years.

Since many of the transit systems average approximately 88,514km (55,000 car-miles) per year and wheel life is around 9 years with 3 wheel turnings, it was decided to relubricate these applications whenever wheels were turned instead of on a time basis.



With the development of the "AP" bearing using rubbing type seals or labyrinth enclosures, it was found that relubrications could be extended beyond the wheel turning period.

It was also established that wheel life was increased on some of the transit systems so there was interest in extending the relubrication period.

As a result "AP" bearings are often used without relubrication on transit equipment operating up to 804,670km (500,000 miles) before wheels are replaced.

The wheel life does vary on the various systems in the United States and ranges from a low of 321,868km (200,000 miles) up to over 804,670km (500,000 miles).

The type of lubrication has also changed since the first grease lubricated bearing was placed in service.

At the start, most of the greases used in the United States were soda base with an NLGI (National Lubrication Grease Institute) "O" Grade with an ASTM (American Society of Testing and Materials) grease worker 60-stroke worked penetration of 310 to 340 at 25°C (77°F).

In service many of these products were not stable and softened to a penetration number

over 400 causing lubricant to leak out of the bearing assembly.

There was also a problem with water contamination, which led to the development and adoption of lithium base greases.

Evaluation of the stability characteristics was made possible by using a new laboratory test in the vibration test rig and ultimately the current AAR M-942-78 grease was developed.

This is a lithium base grease with a 60-stroke penetration of 290-320 and a vibration test requirement with ± 4 G impact for 48 hours in an actual bearing.

After vibration testing the penetration must still be within the 290-320 penetration.

The oil used in this grease has a viscosity of 143 to 168 cST (centistokes) at 40°C (750 min. to 950 max. SUS (Saybolt Universal Seconds) at 100°F) and a viscosity index of 80 min.

Lubrication is commonly carried out during service checks which can run as high as the 1,609,000km (one million miles) achieved by the Timken "AP" bearings installed in the New York City Transit in 1962.

When the bearings are removed from the axle they are sent to the bearing repair shop, where the bearing is disassembled, cleaned, and inspected according to established service limits.

All components are interchangeable except the cone spacer so the defective parts may be replaced with new or otherwise serviceable used parts from inventory.

Cup races with spalls that are not larger than 9.53mm x 9.53 ($\frac{3}{8}$ " x $\frac{3}{8}$ "") after repair can be returned to service.

After inspection the bearings are checked for the correct bench lateral clearance, which is obtained by using cone spacers made to various lengths which will permit the inspector to obtain the correct adjustment.

Following the bench lateral check, the bearing is lubricated and the enclosures or seals are pressed into the cup counterbores. The bearing is now ready to be applied to the axle.

A group of used bearings, carefully inspected and repaired, should perform with a reliability very nearly the same as a group of new bearings.

Reliability leads the way

An increasing number of Australia railway systems are investing in Timken tapered roller bearing reliability.

West Australian Government Railways recently purchased Timken Class 'E' "AP" bearings for use in freight bogies.

The narrow adaptor tapered roller bearings have resulted in "tremendous cost and labour savings" in axlebox maintenance during the last six months.

State Rail Authority of New South Wales has also embraced the package bearing concept with the recent start of installation of Timken Class 'E' "AP" bearings on the first of 1200 new coal wagons.

The NSW network will also use several hundred Timken Class 'G' "AP" tapered roller bearings for use on the 86 class locomotives currently being supplied by Commonwealth Engineering (NSW) Ltd.

These latest contracts represent a continuing swing to Timken "AP" bearings, which were developed for use on railway wagon journals and locos.

(continued from page 45)

air-conditioned day cars of similar layout to the XPT vehicles. The test location selected was between Marulan and Goulburn where speed could be maintained at about 135km/hr over two long sections on both the up and the down tracks. A total of eight test sites were selected that had reasonably consistent track roughness for at least one kilometre. Five test runs were made in each direction at various speeds in both tare and laden conditions. All suspension movements and accelerations for both test vehicles were simultaneously recorded on magnetic tape using a multiplexing system that effectively filtered out all signals above 66.7Hz. Strain gauges were fitted to the BT10 bogie frame and axlebox housing. The test programme included return runs to Orange in the tare and laden condition, to obtain adequate event records for fatigue analysis purposes and a later run to and from Armidale was used to confirm train running time predictions.

Test bogies. The BT10 bogies had primary springs to suit British Rail catering vehicles which have a similar tare mass to the State Rail Authority SDS cars used for the tests. The swing links were shorter than standard with an effective length of 555mm compared with 580mm. This provides the additional clearance required for safe operation on the British Rail southern region, which has a third rail electric traction supply system. These bogies were also fitted with the original GIRLING self-powered wheel slide prevention equipment. The CT22 bogies were fitted with revised air springs to obtain the required lateral spring rates. The suspension natural frequencies were as follows:

Bogie	BODY BOUNCE		BODY LATERAL	
	Tare	Laden	Tare	Laden
BT10	1.0	0.97	0.67	0.67
CT22	0.72	0.70	0.68	0.67

The primary suspension rates of the two designs are similar giving almost identical primary roll stiffness, but the CT22 secondary roll stiffness is about 28% less than that of the BT10.

Test results. The first indication of the ride quality of the test bogies was obtained from a portable ride metre that gives a direct ride index output, averaged over 10 seconds. The maximum readings obtained on the first test run to Orange showed that the lateral ride of the two bogies was similar, although the BT10 made frequent contact at its lateral bump stops, usually at the entry to a curve. The softer vertical suspension of the CT22 gave a significantly better ride as expected.

	BT10	CT22
Lateral ride index	2.3	2.4
Vertical ride index	2.6/3.0	2.3

The highest vertical ride index for the BT10 was due to poorly damped body pitch excited by road crossings and similar behaviour was observed on the run to Armidale where the input originated from short rails laid with joints in line.

The body acceleration recordings for the Marulan-Goulburn test sections were analysed by British Rail to determine the standard deviations of the total rms signal over the range 0-20Hz. This vibration amplitude was taken to be concentrated at the observed dominant frequency. The vertical ride results appeared to be in reasonable agreement with theoretical predictions and were significantly higher than expected for the low wheel to rail conicity conditions. The omission of track twist inputs to the lateral model is regarded as an important factor in this lack of correlation.

Extrapolation of the test results indicated that the BT10 bogie may just meet the revised ride specification at

160 km/hr, whereas the CT22 would just meet this criteria in the lateral direction and would provide a substantially superior ride in the vertical direction.

The tare test recordings were subjected to a more detailed analysis in Australia. The vehicle ride was obtained from a third octave band analysis over the range 0 to 25Hz and the ride index was calculated for each mid-band frequency. These indices were then combined in the usual manner and brought to a common standard by using conversion factors to take account of the track roughness. The most reliable factor was found to be the cube root of the TC1 ratio; in other words, the vibration amplitude was taken to be directly proportional to the TC1.

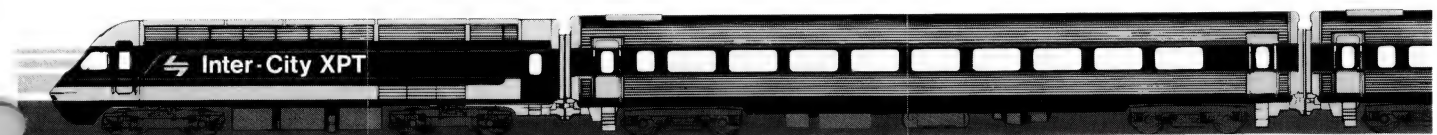
The ride results for the tests at the existing maximum speed indicated that the ride over 90% of the Main South Line between Harden and Goulburn would be equal to or better than:

	BT10	CT22
Lateral ride index	1.9	2.0
Vertical ride index	2.1	1.9

The rate of rise of the BT10 ride index values with speed was greater than that of the CT22, particularly for the vertical direction. The reason for this difference was examined by determining the most significant frequencies using the weighting factors in I.S.O. 2631. The time spent at each critical frequency was then used to obtain an indication of their relative importance on both curved and straight track.

The British Rail analysis attempted to obtain transfer functions by taking the track profile as input and the test results as output, but this gave poor correlation with theoretical models and was not consistent from site to site. The subsequent detailed analysis used the acceleration recordings of the wheel movements as input and this proved to be much more successful.

(to be continued)



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Visit by French delegation

Over the first two weeks of July, a delegation of senior engineers from SNCF (French National Railways) and from the French Railway Industry visited Australia to meet the Railways Authorities of New South Wales, Victoria, Queensland and Western Australia.

The purpose of this visit was to acquire a better knowledge of the Australian Railways, to share mutual experiences and to exchange information on applications of improved rail technology. Although running conditions and technical options of the Australian and the French Railway Network are different, both parties have the same economic preoccupations and the same desire to choose the best economic and technical options for optimal running conditions.

In this constant search for better performance, SNCF, in close co-operation with the French Railway Industry, is implementing an important programme of modernisation of equipment. As a matter of fact, the French National Railway Network is a permanent testing ground for both national and export equipment; this enables it to strive for better efficiency, reliability, safety and comfort in rail transport.

A good illustration of this is the new 500 electric locomotives, designed in 1975. These locomotives have undergone improvements leading to the development of a new generation of locos. The application of thyristor converters makes it possible to adjust traction effort to optimum adherence limits and to achieve electric braking in the best conditions. The locomotive reliability has been greatly improved; for instance a level of two failures ever one million kilometres and time between general overhauls increased to four million kilometres (instead of every 2.5 kilometres which was the case previously). Furthermore, maintenance costs have been halved. In order to improve passenger services, a hundred double decker electric multiple units (known in the railway jargon as emus) are being built. The 1981 figures are:

- 1,186,000 passengers on the Paris suburban network,
- 725,000 passengers on the intercity network.

Scheduled for use in the Paris suburban area, each train will provide 534 or 718 seats according to its formation. The units are equipped with the famous chopper equipment and a regenerative electrical braking system recently developed by the SNCF in collaboration with the rail industry.

However, the best example of this co-operation is the TGV (High Speed Train) which has been running between Paris and Lyon since September 1981 at 260 km/h and for which a 400 kilometre new line has been laid. One hundred TGV Train sets have been ordered and 52 of these are already in operation. All are dual current except three which will be tri-current to run on the Swiss network.

The total increase of 40% in passenger traffic over the past ten years as well as an increase of 100% between Paris and Lyon since September 1981, illustrates an adaptation to passengers' needs that has resulted from current research.

In the field of freight transport, while SNCF carries 200 million tonnes a year, i.e. 64.5 billion tonne/km and runs perishable goods trains at 140 km/h, the French wagon builders are introducing technical innovations to their equipment. They have increased the overall capacity of the wagons and lightened their weight. They have generalised the use of bogie wagons (40% of the SNCF fleet are bogie wagons) which makes it possible to achieve higher speed.

They adapt ordinary wagons to products, like the covered wagon equipped with sliding sides used for palletised loads or the mechanical skidding flat wagons designed for loading by forklift trucks and cranes. France is also developing the combined road and rail transport — piggyback — and its railway engineers and manufacturers have brought in a new generation of wagons which are robust and adaptable.

An Australian group, including engineers from the Australian Railways Authorities and Industries, will see all these traffic operations and technical improvements while meeting again with the SNCF and the French Rail Industry in France later this year on their European tour.



"Small" steam in Victoria

When steam gave way to diesel electric motive power on our railways in the early-fifties, much of the glamour and romance associated with railway operation faded. Today many people are working hard to preserve some steam presence by restoring and maintaining in running order steam locomotives that once were destined for the scrapheap.

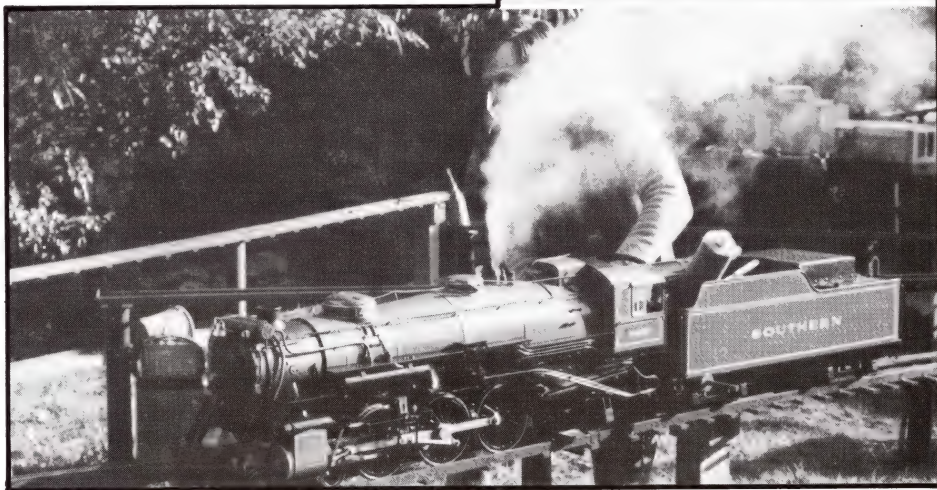
Wherever steam railways operated there is this tremendous urge not to let it die altogether. However, long before the demise of full size steam there was a world wide fraternity of people who were building miniature replicas of full size steam locos that could be steamed and fired and driven just like their big brothers.

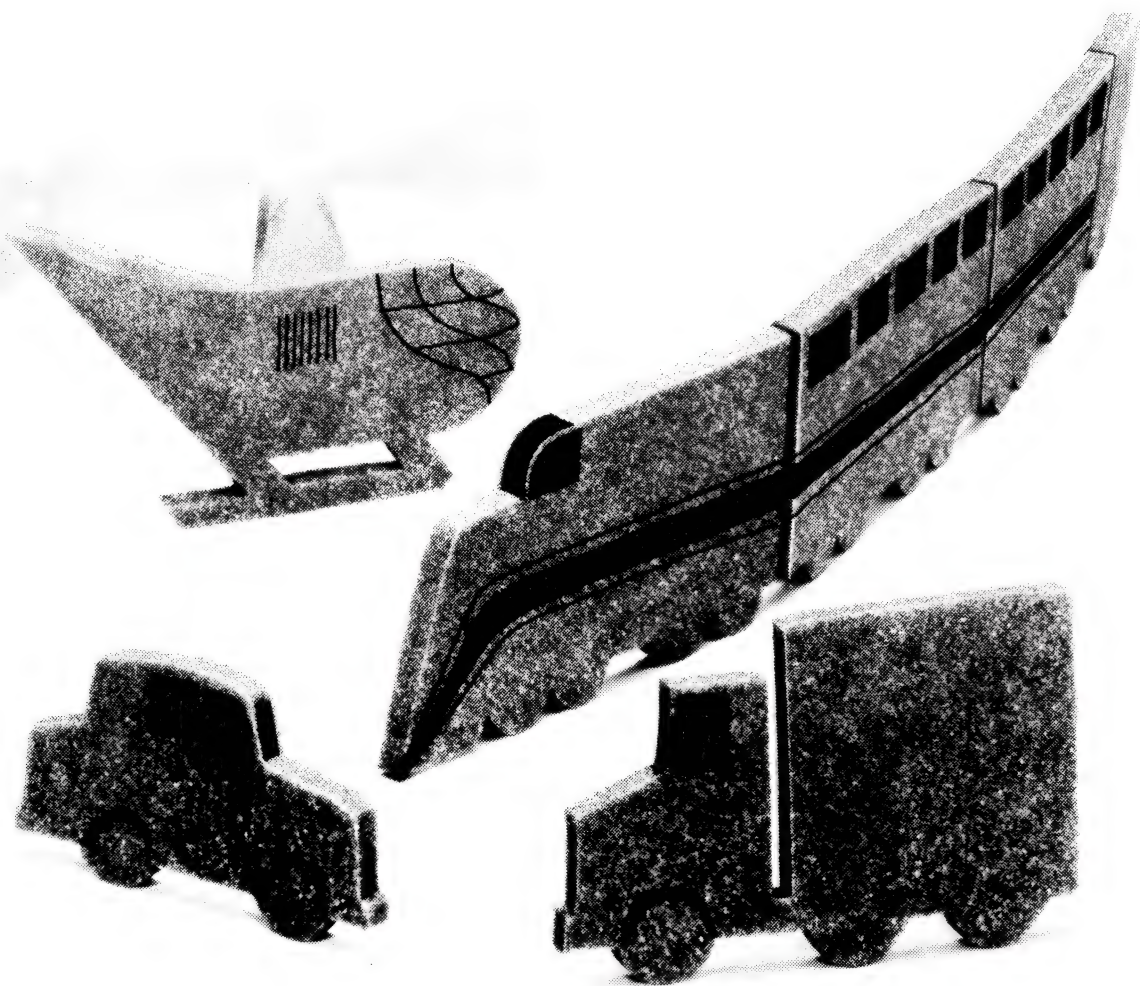
This movement began in England and was slowly spreading between the wars in all English speaking countries. Since World War 2 this movement has burgeoned.

The year 1941 saw a small group of enthusiastic builders/drivers come together to form the Surrey Hills Live Steamers in a Surrey Hills home. In 1964 this became the Steam Locomotive Society of Victoria with permanent facilities at Rowans Road, Moorabbin.

Since that time, on land held from the Moorabbin Council, the society has developed an extensive complex of steaming facilities, signalling and trackwork set up for the express purpose of testing and running miniature steam locomotives.

All locos are privately built and owned and on the first Sunday of each month except January the grounds are open to the public and some of these miniature replicas may be seen operating.





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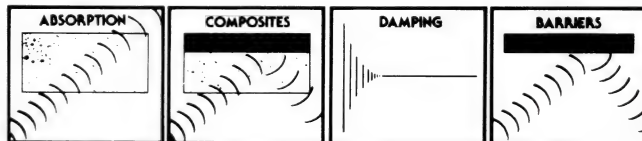
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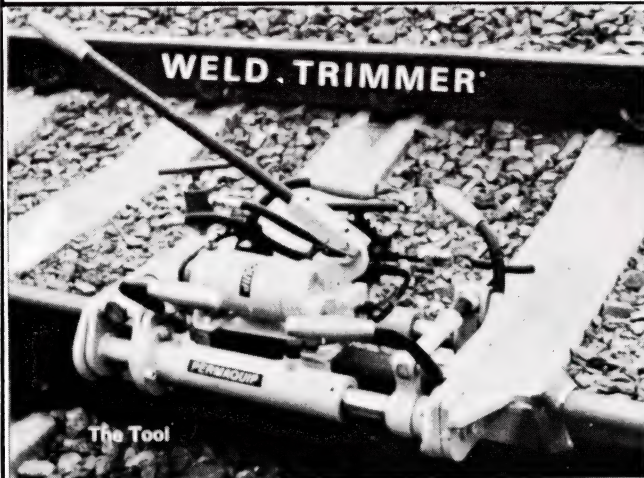
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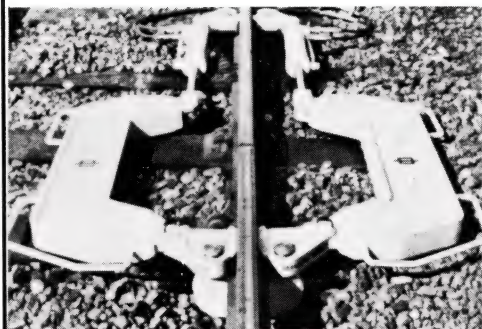
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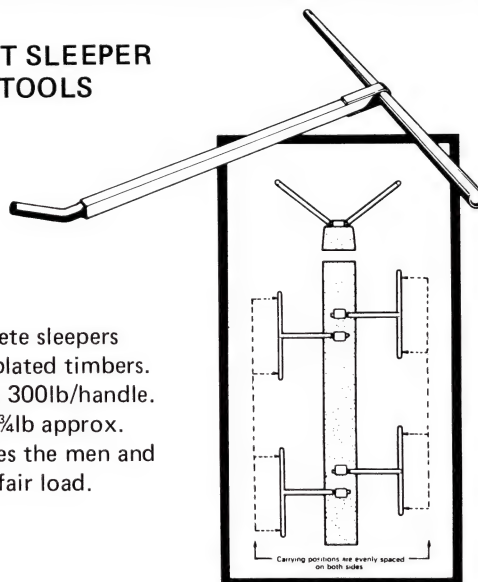


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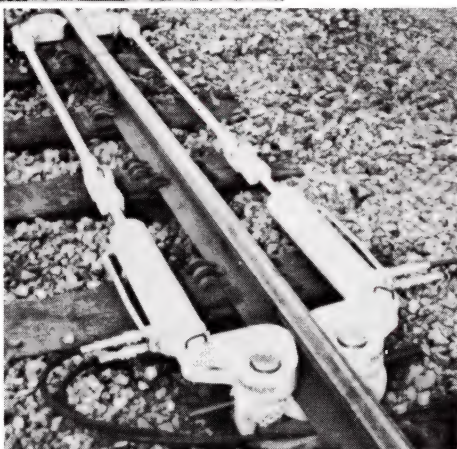
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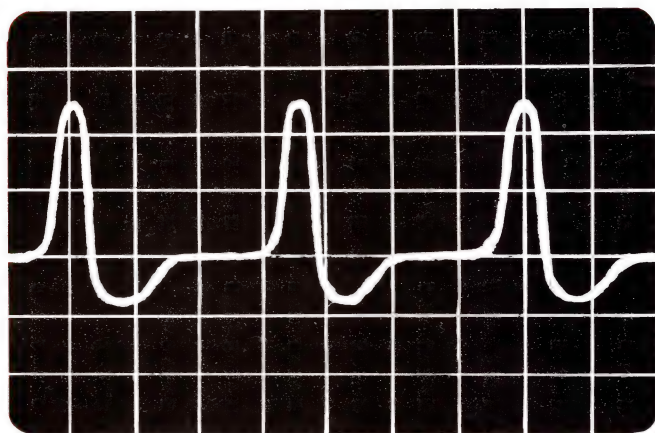
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Locomotives of New South Wales 1855-1980, Vol. 1 compiled by Alex Grunbach. 170 x 245mm, 120 pages, 130 half-tone and 3 line illustrations. Australian Railway Historical Society (NSW). \$6.95 plus \$1.50 postage with paper endcovers or \$9.95 plus \$2 for cloth-bound limited edition. Older NSW railwaymen who recall the 1955 NSWWR Centenary may well have a copy of the souvenir book called 'A Century of Locomotives', jointly published by the old Department and the Australian Railway Historical Society. 'A Century Plus' of locomotives followed later; ARHS are now completely revising the whole work as a series of five expanded volumes entitled 'Locomotives of New South Wales, 1855-1980'.

The new series is divided by basic type. Accordingly Vol. 1 groups all 0-4-2, 2-2-2, 2-4-0, 4-4-0 and (goods-only) 0-6-0 and 2-6-0 types. There are thirty engine classes in all dating from Loco No. 1 of 1855 to the 27 class Moguls of 1913. One fears that the subsequent four volumes will run short of classes. In Vol. 1 each class is described in text and half-tone photographs. An appendix contains neatly tabulated summaries of technical data in Imperial and metric units. There is a list of survivors of withdrawn classes, including advice on where they are preserved.

The text is well-written and well-edited, and while hyper-enthusiastic NSW train buffs will doubtless claim to have seen every picture before, it must be said that an astonishingly high proportion of them are quite new to your reviewer. The reproduction, on art paper, is as sharp as modellers will need for detail work. Illustrations include some interesting shots of engines working in traffic — many at locations which NSW railwaymen will still be able to recognise — and some excellent views of very old 4-4-0, 0-6-0 and 2-6-0 engines clanking out their final years in remote corners of the State before the ubiquitous 48 class Alco diesels thankfully swept them into history. Ship buffs, too, will enjoy four fine photographs. Three are of old Newcastle, with a forest of sailing-ship masts along the present tug quay. The shunter is one of the E17 long-boiler 0-6-0s, the last of which Mr David Hill showed us at Sydney Terminal during the SRA's 125-year celebrations. The fourth picture depicts the Byron Bay wharf in 1915, with what appears to be the North Coast SN Co's handsome express mail steamer **Wollongbar** alongside and tugging heavily at her mooring ropes (she was later wrecked there).

Three horses are heaving an old QR-looking fridge car over some pointwork of which the NSW Civil Engineer would not have approved. But then Byron Bay was a PWD, and not a Railways' wharf. Honour is preserved.

Locomotives, Vol. 1 is commended to all who have copies of the previous works, for it does not duplicate them.

Peaks, rush hours, high peaks

In the last issue of Network we spoke of track capacity and flows of some key city railways in Australia and overseas. In this article, the next in the series, Network looks at the problems with which railway systems around the world must cope — the rush hours.

On most electric railways, these maximum flows of people occur only for quite short times of the day. Such times are the so-called "high peaks"; which may be as little as 30, 20 or even 15 minutes of the nominal "peak period" (the one or two hours in each weekday morning and evening through which the railways consistently operate their densest frequency of trains). The "high peak" is fixed essentially by the patrons' travel habits, i.e. by the society that the railway serves rather than by the railway operators. Thus the high peak varies from country to country. Some Latin systems enjoy four high peaks daily, due to their patrons returning home for their midday siesta. This doubled asset utilisation helps make these lines almost profitable; only recently was the Madrid metro transferred from private to public ownership. To a lesser degree, the high peak also reflects the seasons and the kinds of areas served.

Loads on routes mostly serving factory workers will tend to "peak" earlier than those serving mostly clerical and professional people. Melbourne's Glen Waverley and Sydney's Upper North Shore lines are instances of this. And because the high peak is a flow of people rather than of trains, it is a dynamic, living thing: it moves as a surging wave of people, rather than trains, through the system.

On Sydney's main western line, for example, the heaviest passenger densities will be attained up to an hour earlier west of Parramatta than they will on the City Railway itself. Many patrons do not travel as far as the city. This point may seem rather obvious, yet it is often forgotten by novices in the transport-planning community. Another often-forgotten point is the advance-timing of the main operating effort. Activity in the electric car depots peaks around typically 05.30 for the morning peak and 15.00 for the

evening one — earlier for the outlying depots — because virtually all the trains have to be out in the system and running well before 07.00 and the 16.00 after-school and factory rush. Similarly it is not generally possible, because of the journey times attributable to the sprawled low-density nature of Australian cities, to obtain much more than one loaded trip per train during the peak. A 10 to 12½ percent "second trip" factor is regarded as good going for such a system; the more compact metros of course can do better.

Thus empty stock from the factory workers' trains is already being worked back into the carriage sidings long before the white-collar high peak is in full cry. This often gives rise to critical comment by the observant yet uninformed passenger who, on seeing empty stock lying "unused" in the sidings at Jolimont, Mayne or Prince Alfred every morning, will ask his fellow-standee what kinds of people must be running their railway, or why the Government is buying new trains when the railways don't operate the ones they already have.

Depot maintenance activity is, in fact, always timed to commit the maximum number of cars and trains for the peak, and including cars in the main works for heavy overhaul, it is unusual for the fleet spares holding to exceed 10 percent. Some systems run on only 6 percent, but less reliably. Given sufficient line capacity, the most economic use of rolling stock is to add to a peak-period interval service run from (say) 06.30 to 08.30, and 16.00 to 18.00, the relatively few extra trains needed to lop the top off the high peak load. Such trains can be run to special, unique timings and stop patterns, and because they run the fewest km per day they are usually the oldest, most maintenance-intensive cars in the fleet. Where there is no such line capacity

By
a special
correspondent

across town, only the peak-period service can be operated, and the high peak flow of people has to be carried as more standees, riding under deteriorated travelling conditions.

Nobody likes this, but unless the crippling costs of building extra tracks are accepted by the community, a measure of "controlled crowding" is unavoidable.

On pure subway systems, this has long been a standard operating philosophy.

Crew shortages. On many systems in the western world there is an increasingly difficult problem in providing enough trains per hour to lift the people per hour. Despite the general level of unemployment, the job-security offered by railway work and increasingly attractive wage rates and fringe benefits, railways in many western cities (especially Anglo-Saxon ones) are finding themselves unable to attract enough people (especially guards) to run their urban trains.

Unsocial working hours are a major cause. This shortage, coupled with rostered staff sickness circumstances, results in last-minute cancellations of trains, dislocated services, and where extra stops or out-of-sequence operation is involved, late running and frayed tempers all round. The flow rate in terms of people per hour is more or less attained — after all, the people are out there, fuming on the platforms to fight their way aboard the next packed train that pulls in. But the quality of the service declines most seriously.

The Moscow Metro is operated entirely by women — and it is acclaimed as one of the world's best in respect of reliability and quality of service, the essential human ingredients that must be added to the technical formula of people per hour".



SRA's Lidcombe interchange.

Train service planning

problems. Network knows of only one railway having the operator's ideal of a totally junction-free route, worked by absolutely identical trains calling at every station. This is the Glasgow subway, a 1 215mm narrow-gauge route that was originally designed for cable traction and is laid out in a circle. In contrast, London's Circle Line has many junctions with the Metropolitan, the District and the Hammersmith and City, and Sydney's City Circle is a horse-shoe shape. On such lines, and especially on suburban railways, the Glasgow Subway's ideal is massively compromised by co-ordination and mixing problems.

The first and worst compromise for the Australian planner is that he is not providing a totally-new railway, such as London's Victoria Line, the Paris RER or the Hong Kong metro. He is working within the constraints of a pre-existing system, whose geography essentially dates from the last century. The city railways in Sydney (opened by section in 1926/32/55/79) and Melbourne (Loop opened in 1980/83) are the

exceptions that ease operating problems. But most "new" suburban services are simply a case of extending further down the main lines, and in generating more trains they serve to compound rather than to ease the planning problem.

These factors of history and geography are not to be underestimated: in Brisbane, they divided the suburban system into two operational entities for almost 90 years, and to see a Kingston train pull out of Petrie after the Merivale Bridge was opened was to see the fulfilment of an 80-year dream. And in Melbourne, history and geography created an imbalance of flow — people and trains — between western and eastern lines for almost a century, an imbalance that the new Loop solved.

Some of the operating implications of these geographical problems are obvious, and some are subtle. To quote Sydney again, to get from the Short North* to the City Railway, Up ** suburban trains from Hornsby must cut across the flow of interurban and other trains from the west going into Sydney



Cab and controls of an SRA Double Decker electric train.



VicRail electric train on a steep grade between Ferntree Gully and Belgrave.



South Australian Red Hen emerging from a tunnel on the Belair/Blackwood line.



An aerial view of Brisbane's Mayne Flyover.

terminal, and happily a flyover was provided at Strathfield for them to do just that. But for Southern Aurora or Spirit of Progress to reach Sydney Terminal from the Main South the express must, between Lidcombe and Homebush, move from the southern to the northern pair of four very busy tracks.

Here there is no grade separation: the crossover move must take place over flat junctions at the height of the morning peak. The move is done west of Flemington to avoid the outbound empty electrics moving back into Flemington car depot. The fast electric trains Up from Campbelltown must likewise cross the traffic flow. It would be nice for all these south trains to be able to leave the Main South around Glenfield, crossing the Georges' River to join (say) a third track on the East Hills line, and thus to enter Sydney Terminal of the City Railway without further conflict.

But there is no such rail link across the Georges' River, although a "Direct Southern" link from Glenfield to the East Hills dead-end has been proposed on many, many occasions.

* Hornsby to City via Epping and Strathfield
 ** Up to Town, Down away from it.

Incompatibilities. Trains run to serve people, and cannot serve them unless they stop. But stopping takes time, and this helps to create the next major planning problem: the mixing of many different types of service — different in respect of performance, destination and stop pattern — on a multi-function railway.

Every effort is made to keep long-distance traffic previously exposed to several hundred km of single-line crossings and thus delay risk, or lower-

performance diesel-drawn country commuter trains, or even key goods services, out of the peak period suburban flow.

But often this goal is unachievable. The market insists, for example, that daylight express trains leave and that overnight sleeping-car services arrive between breakfast time and 09.00, even though the traffic planners are well aware of what the repercussions can be. Even if on time, the 80km/h "path" of the inbound express will cut a disruptive swathe through a train plan crowded with 40km/h "all stations electric" schedules, displacing two or even three suburbans over an approach that can be up to 50km long — unless there are extra fast tracks, and the through express can be slipped between two non-stop electric paths (e.g. Strathfield/Redfern, Caulfield/Richmond).

Again, the long-distance express checked by a signal cannot be halted in a suburban platform — some opportunistic commuter will inevitably try to push aboard, creating (for safety reasons) an extra unscheduled station-working cycle, and compounding the delay.

So its driver must halt short of the platform, trailing his 15 cars into one extra signal block to the rear, delaying the following suburban, and perhaps even blocking a critical junction or crossover.

So serious, in fact, are the implications of dislocating a complex suburban train plan involving scores of trains and thousands of commuters, that on some systems a late-running long-distance train will have to yield its priority to, and follow, an all-stations electric. The resulting crawl into town at the electric's lower average speed of typically 40km/h avoids stops but as the express gets later and later, and

appears to be going slower and slower, there is inevitably some comment by exasperated long-distance travellers. Yet what is the alternative? Where timetable "paths" simply do not exist, and where extra tracks cannot be created save at prohibitive financial and social cost from lineside land resumption, it is impossible to satisfy everybody's conflicting needs — and the relatively few hundred long distance travellers are the people who often have to suffer in preference to the many thousands hurrying to work by suburban train.

Steps in service planning.

Unless train densities are very low the suburban timetable planner must first identify all these problems, and then examine the section that is critical in terms of track capacity, and thus train movements. Usually it is the section that's closest to, or that extends right across, the city centre. But there are significant exceptions. To revert to Sydney's western line, for example, four tracks from the west and two from the south converge at the important junction and interchange station of Lidcombe; thereafter there are still only four tracks to Homebush and six to Strathfield and the city. Throughout the morning peak, a steady procession of Up trains pours into Lidcombe; express diesel, interurban and suburban electric from the south, the same mix under electric haulage from the west, and an occasional goods train as well. Immediately after Lidcombe some trains must be switched onto the Metropolitan Goods Line that peels off the Up Fast, or sorted between the Up Fast and Up Slow lines, thus pre-positioning the city-bound passenger trains for a second switching at Homebush onto the Up Main line for Sydney Terminal, and the Up Suburban (mostly for Wynyard High Level) commuter lines.

Trains arriving from the west and Liverpool via Granville will already have been pre-sorted between the slow and fast tracks at Granville and, when current quadruplication works are complete, some will be pre-positioned as far west as Blacktown, where many of them join from Riverstone on the Richmond Branch.

This happy situation does not apply to arrivals from the Main South which, as we have already seen, must be sorted out in the critical section itself, using flat junctions throughout. Such an operation is extremely complex and is a major consideration when planning southern and western services generally.

Problem areas like this are a major plank in the case for the programme of centralised, strategic, remote regulation of traffic, as distinct from control by signalmen in the individual boxes. Having determined the maximum number of trains that can be worked through his critical section, the timetable planner then looks at the demand side and allocates his services between converging branches or, on a main line section with tapering demand, between the various turn-back stations. Demand tapers, but the supply of trains has to be in quantum jumps.

On a network able to handle 24 trains/h on its central section (i.e. the 2½ min service advertised as a 2 min/3 min frequency) the planner may divide the flow into two 12 train/h (5 min) services at the first branch on one side of town. On the other side the option may be to turn-back 6 trains/h at the first suitable station, reducing the flow to 18 trains, and at the next junction to turn-back another 6 trains/h and divide the balance of 12 trains/h into two 6 trains/h (i.e. 10 min) services onto the most remote branches.

As previously mentioned, 24 trains/h is getting pretty close to the absolute maximum number of trains that can be reliably funnelled into a central trunk sector, and achieving it calls for first-class system communications and a high degree of co-ordination skills on the part of the Train Controllers regulating the traffic.

Computers are being used to help in this task by detecting abnormal situations e.g. out of sequence running, late trains etc. Overseas, they are also being used to calculate the implications and offer the Controller a range of options to select from.

Once told how service is to be adjusted, the computer will instruct the signal system to re-signal and route the trains. Because the goal is to move people and not just trains, the indicators and pre-recorded announcements that advise the public are every bit as important as the equipment that selects the appropriate route in front of each train.

This communication function is expressly built into the computer programmes that run and adjust the service; the MURLA installation in Melbourne is a model of its kind.

Conflicting movements.

Conflicting movements at flat junctions are bad news. The planner loses capacity, and the trains and passengers lose time. Typically, if a line is signalled for routine operation of 24 trains/h, the addition of a double track junction on the flat and the mixing of loco-hauled trains into the flow will reduce the capacity to only 18 or 19 trains/h, a loss of 25%. Grade-separation works called "flyovers" (a bridge) and "dives" (a tunnel) are needed to avoid this. They are, however, very expensive

(continued on page 58)



Westrail's new suburban stock



QR's 3-car Emu electric trains.

The clip



Pandrol Australia Pty Ltd,
3 Stanton Rd, Seven Hills, NSW 2147,
Ph: (02) 624 4377 Telex: AA24133
28-30 Davison St, Maddington, WA 6109,
Ph: (09) 459 5255 Telex: AA94531

(continued from page 56)

because of the extra space and gentler railway grades.

The world's first flyover is believed to have been built in 1844 on the old London and Croydon "atmospheric" (i.e. vacuum-pipe-powered) railway. The first such work in Sydney is believed to have been the Illawarra Dive, built at Redfern station before the opening of Sydney Station in 1907. But probably the best-known and most-photographed flyovers in Australia are the Flying Junctions, built to avoid the problem of conflicting movements immediately south of Sydney's Central electric station. Designed by the Dr. J. J. C. Bradfield and constructed as part of the City Railway Project in the early 1920s, they permit a wide range of scheduled and emergency movements, without conflict, between Fast and Slow or Illawarra and western, or the various City Railway lines.

Not all options are routinely used, but it is true to say that the genius and vision of Bradfield in laying out this complex — still one of the largest in the world — has meant as much for Sydney rail commuters living south of the Harbour as Bradfield's Harbour Bridge itself meant to those living to the north.

It is significant that the approaches to most of London's great termini are still much less well-endowed than Sydney. Also close into Sydney are the tunnel at Redfern which enables engines and empty coaches to move from Eveleigh depot to Sydney Terminal under all running lines, and the previously-mentioned Illawarra Dive, which takes Terminal and Darling Harbour traffic to and from the Illawarra line without conflicting with the western electric services.

Other examples are the eastern Suburbs Line entry on the Illawarra line, and on the west the Strathfield flyover complex, the Richmond branch flyover at Blacktown and a completely grade-separated complex of freight routes called the Metropolitan Goods Lines in the inner suburban area.

The subterranean burrowings of the City and the Eastern Suburbs underground systems are designed primarily for passenger convenience at interchange stations but these, too, provide many flyover functions totally eliminating flat-junction conflicts under the city. All these aids keep the suburban flows comfortably up to the required 24 trains per hour, as originally conceived by Dr. Bradfield after his inspection of the New York subway system some 70 years ago.

In Melbourne, the major long-established flyover complexes are the grade-separation of the Essendon and Footscray/Geelong lines between North Melbourne and Flemington, and the Glen Waverley branch flyover at Burnley on the main Ringwood line. Later complexes include the Alamein flyover Camberwell (also on the main Ringwood line) and the flyover at Richmond which sorts out the directional flows of the Ringwood line itself.

There are also a number of goods line grade-separations in the North Melbourne and Footscray area, and the well-known flyovers that bring standard-gauge trains over all broad-gauge tracks at Broadmeadows and finally into Spencer Street. The biggest grade-separation works in Melbourne are the diving entrances to the Loop, which are operationally every bit as significant as Sydney's Flying Junctions; the Melbourne Loop System is signalled for the bi-directional working to reflect the counter-flows of the morning and evening peaks, and a nominal 90 sec headway.

It is unlikely that flows exceeding 24 trains per track per hour will need to be timetabled.

Overseas visitors are astonished by the huge Flinders Street yard complex, which has been operated since its inception completely on the flat — i.e. without the benefit of any grade separation works whatsoever. Until quite recently the signals were mechanical semaphores, too. It is only when the yard is examined in the geographical context of the whole Melbourne system and its operating pattern, that one realises how despite its massive ladders of slip points and crossover junctions, Flinders Street is operated essentially as a bunching together of a number of discrete, parallel, two-track railway lines that do not conflict with each other, and not as a fully-integrated cross-flow system as in western Sydney.

In this way the number of conflicts was kept to the minimum, the major sources of delay being the imbalance between eastern and northern/western workings, and the consequent need to dispose of surplus incoming eastern services by reversing them into the Jolimont car sidings, where five groups of sidings* were cleverly fitted-in by some forgotten Edwardian planner between each pair of main running tracks.

Despite this ingenuity, the partial reversing operation was long a source of conflict, because, for the trains

concerned, it changed the through platforms into the equivalent of a dead end terminal road. And not many people realised that with Number 1 platform at Flinders Street totally committed to long-distance traffic, there were only 10 platforms available to handle all the trains moving over 10 intensively-signalled tracks coming through Richmond (Prince's Bridge has three platforms for two tracks).

This turn-back operation cut the line capacity substantially back from the 24 trains/h of which the approaches (now the through-running Loop) were capable, and had disastrous effects on punctuality.

In Brisbane there is only one flyover, at Mayne where the busy Ferny Grove branch leaves the North Coast line. This flyover, newly-built for the 1979 electrification, also allowed a nearby goods yard complex to be developed. It crosses Breakfast Creek and is integrated with a second and flat junction on the branch itself, whence tracks loop back across the creek into the new suburban car yard.

Elsewhere, QR is still able to operate its Brisbane suburban services totally over flat junctions, largely because of its capability to run trains from the north side that terminate in the city through Central to Roma Street, and thence around the Normanby Loop behind the city to the yards at Mayne.

This is achieved with minimum conflict to trains arriving from the south side and the west because there is adequate platform capacity at Roma Street, and this avoids queuing the trains on open line.

Traffic densities have not yet called for flyovers at suburban junctions in Adelaide or Perth.

* Thus the sidings were known, reading northwards, as the "Sandringham", "Essendon", "Oakleigh", "Caulfield" and "Camberwell" sidings. Additional "Country" and "Collingwood" sidings lay north of the running lines, and Jolimont car shops to the south. There were also western car sidings on the viaduct.

The Australian Urban Series certainly makes stimulating reading. I wonder if our railway colleagues in other parts of the world could offer similar material on their suburban history. If so, I would be delighted to consider it for publication. —Editor.

Next issue. We look at capacity and car design for the suburban systems.



TOTAL WEST

The carriage of parcels and LCL (less than car load) freight has been a mounting problem for railways both in Australia and overseas for many years. This traffic, invariably linked with common-carrier obligations, has been a prime source of loss-making operation. It is easy to identify the increasing difficulty for rail operators in handling this type of freight. 'Smalls' freight was a major traffic task for rail systems in the nineteenth and early twentieth century.

The railway was at that time the only transport system capable of handling the task. These were railways operating with low labour costs and small capacity rollingstock.

Between the two world wars, the commercial motor truck had developed to the point where it was more than just a delivery vehicle, and could actually compete for the line haul. The railway systems came under the threat of competition.

State Governments had massive investment in their railway systems which provided employment for thousands.

Regulation was introduced to suppress the threat of an emergent trucking industry. This was only permitted to operate in non-rail served regions. The developing technologies which had produced the commercial road truck, also were working in the railway industry. Steam locomotives yielded to diesel traction having superior power and availability. Freight wagons productivity increased substantially as better design techniques and specialisation permitted higher load bearing capacities for comparatively low tare weight.

The inflationary spiral of the post war era had brought about dramatic increases in labour costs. At the same time, the techniques used to handle LCL traffic remained essentially constant. Government regulated freight rates restricted the passing-on of escalating operating costs to the customer. It was reasoned that it was in the community's interest to keep freight rates low, even at the expense of increasing railway operating deficits.

In 1975 the Government of Western Australia commissioned a study into the transport needs of the South Western part of the State. The findings of SWATS (South Western Area

Transport Study) persuaded the Government to progressively deregulate 'parcels' and general goods traffic. The community had signified that it wanted freedom of choice in the transport mode it used. Deregulation was to be brought about progressively within gradually increasing radii from commercial centres. The first stage was introduced in April 1980.

Westrail set about monitoring its success in the competitive market closely. Whilst 'smalls' traffic represented only about 2% of its total annual tonnage a large number of jobs were directly related to this business. By early 1981 it was clear that Westrail would lose substantial ground under the full deregulation of general goods traffic. Clearly a fundamental change in the traditional style of operations was necessary.

Mindful of the steps taken by railways in other parts of the world, Westrail evaluated a number of optional strategies.

Westrail could cut its losses and withdraw from the parcels and goods LCL market entirely. It would certainly lose 400,000 tonnes of traffic, but the main impact would be on the staff, with the loss of an estimated 800 jobs. Neither of these consequences was considered acceptable.

Two different 'regional freight centre' concepts were studied which provided for a restricted line haul network with private hauliers handling the final distribution. Certainly, a large number of jobs would be saved but the economics were not attractive due to extensive double handling. High terminal costs were at the basis of the original problem.

Whatever solution was to be adopted, had to provide a service at a frequency and price which suited the customer. Market analysis had demonstrated that many clients were looking for 'door to door' delivery.

The final solution lay in the formation of a 'joint venture' with a private freight forwarding and road transport company. The comparative modes of road and rail each had a part to play, rail in the line haul of consolidated wagon load freight and road with its inbuilt flexibility. The State Government, in late 1981, approved of the calling of submissions from private road hauliers to join in a 50/50 partnership with

Westrail to establish a transport company to handle parcels and general goods freight. A number of companies made formal approaches and after detailed negotiations, Mayne Nickless Ltd was selected as a joint venture partner.

The new company "Total Western Transport Pty Ltd" (Total West) was launched by the Deputy Premier of Western Australia and Minister for Transport, the Hon Cyril Rushton, MLA on the first of July 1982 after several months of intensive effort by Westrail and Mayne Nickless Ltd.

Concurrently with the introduction of Total West, the State Government was able to accelerate its deregulation programme. General freight transport was declared free to commercial competition on July 1 1981.

Total West is operating out of a number of leased Westrail metropolitan and country depots and with a complex network of accredited agents is offering a daily transport service to over 200 communities in the southern half of the State.

The new company's motto is "The best of both worlds", and that will be the basis of its operations. Offering door to door, door to depot or depot to depot services, Total West will use the transport mode best suited to the individual task.

Westrail's interest is two fold. Firstly as a partner in a spirited new freight transport company and secondly, in retaining a share of consolidated wagon load freight from Total West on rail.

A number of Westrail staff have been seconded to Total West with the option to remain with the new company or revert to Westrail after a 12 month period. Other railwaymen displaced by the new arrangements and who preferred to stay with Westrail have been diverted to other duties. No employee has lost his job.

The management and directorship of Total West comprises a blend of staff and executives of the two parent companies. Westrail's Commissioner, Mr W. I. McCullough, is the inaugural Chairman of the Board.

Mr McCullough summarised everyone's thoughts when he commented, "We have taken a bold step and one upon which I believe history will judge us well".



*Total West Pantechicon at Westrail Centre
Inset: Signing the articles of agreement for incorporation of Total West (left to right) Mr W. McCullough (Westrail), Mr Ian Webber, Mr J. Garton Smith, General Manager Total West.*

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Western Australia



 WESTERN AUSTRALIAN DEPARTMENT OF TOURISM



Parclem DOT 0130

SRA's biggest train

The State Rail Authority recently introduced into continuous service its biggest train ever — a 42-wagon train capable of carrying 3,200 tonnes of coal.

The "jumbo" train completed four round trips on July 11, delivering 12,800 tonnes from northern coalfields to the Newcastle seaboard export facilities at Port Waratah.

It is expected that three more of these trains will be progressively introduced, increasing the export capacity through Newcastle by two million tonnes per annum.

Fares reduction

To encourage InterCity and InterUrban rail travel over the winter months, VicRail has reduced the fares on specified rail journeys.

Pensioners and family groups benefited from the cut price fares, some savings being as high as 60%.

The promotion operated from mid-June to mid-August, a time when VicRail's non-suburban services can cope with additional traffic. The reduced fares applied to nominated mid-week off-peak and Saturday InterCity and InterUrban services.

NZ appointment

Mr A.R. (Ash) Thomson is New Zealand Railways' new Chief Traffic Manager. He replaced Mr B.B. McKeown who retired on 20 July 1982 after 40 years service with Railways.

In his new position, Mr Thomson is responsible for Railway traffic operations in both North and South Islands.

Sir Zelman joins in

In its continuing role in visual management, Railways of Australia sponsored the St Kilda Football Club Former Players' Day on Saturday July 31. The match was between St Kilda and North Melbourne.

Both the President of St Kilda, Mr Lindsay Fox, and President of North Melbourne, Mr Bob Ansett, attended the particular match.

Also in attendance as guests of the St Kilda Football Club were the Premier, John Cain, and immediate past Governor General, Sir Zelman Cowen. Sir Zelman entered the spirit of the ROA sponsorship by guessing the half time score of St Kilda v. North Melbourne. Sir Zelman estimated that St Kilda would kick 3 goals 4 behinds with North Melbourne 7 goals 8 behinds.

The actual score at half time was St Kilda 6 goals 7 behinds to North Melbourne 12 goals 8 behinds.

Unusual load

An unusual freight move was made by Westrail from Bunning Bros Welshpool siding recently. Two jarrah laminated bridge beams, 28 metres in length, were loaded onto two flat top wagons — their destination Victoria.

The Operations Manager for timber products at Bunnings, Mr Bob Street, said "We chose Westrail as the transporter because rail was the only transport mode capable of handling this special consignment."

Mr Street applauded the efficient way Westrail tackled this transport task and the technical advice received for the consignment.

The bridge beams have been constructed by Bunning Bros for the St Kilda Shire Council for the Elwood Canal Project.

Appreciation . . .

Dear Sir,

As you know, following the changes in Administrative Arrangements which were approved on 7 May, I have moved from the transport field to become Secretary to the Department of Defence Support.

Although my new assignment will require me to keep in touch with developments in the transport field, it seems unlikely that I will have the same degree of contact with the railway systems as I have had in recent years. I would therefore be grateful if, through your Magazine, I could express my appreciation for the many courtesies which were extended to me whilst I was Secretary to the Department of Transport by all those involved with railways management.

Yours sincerely,

C.C. Halton

Cheap packaging

The freight and transport industry is often unfairly accused of damaging goods in transit, according to international marine insurance specialist Mr Peter Sandall.

In the great majority of cases the packaging is just not up to the task, says Mr Sandall who heads marine insurance operations in Australia for world-wide American International Underwriters.

Speaking at a recent Victorian Trade Development Group Seminar in Melbourne, he said not enough thought was given to the nature of the goods to be shipped and the types of handling they will face.

"Some firms go through market research, design and manufacture of a product, find buyers and sign contracts. Then, with the product rolling off the assembly line, ready for shipment, they raise the matter of packing and often accept a rushed solution".

Mr Sandall urged exporters to select packing material to suit the goods being moved.

"Items should fill their bag, box or carton completely, and contribute to the strength of the package.

"Fasten articles or block them to prevent movement and damage either to the articles or to the container.

"The design capacity of the box, bag or carton should not be exceeded. Bracing or blockings should distribute the weight of contents over interior surfaces, not concentrate it on critical points.

"Unitise, palletise or assemble cargo into the largest practical unit consistent with handling weight and size. A unitised load of 50 cartons, adequately wrapped, strapped and provided with a pallet or skid-base has a greater survival factor than 50 cartons handled individually", he said.

"Unitised cargo invites use of mechanical handling equipment, substantially reducing exposure to rough manhandling, but neither this form of shipment or containerisation are substitutes for adequate packaging. "Extra steps taken to care for cargo should be considered an investment — not a cost".



Sign of the times

The electronic age has taken over from a piece of history at Sydney Terminal Station.

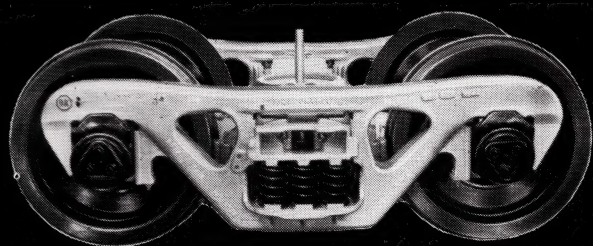
The country train indicator board — a famous landmark for over 75 years — has been donated by the State Rail Authority to the New South Wales Museum of Applied Arts and Sciences. The old board measures 12.1 metres long and 7.6 metres high, and will be re-erected and preserved for visitors to the Museum.

The historic indicator was too big and yet inadequate for the Restored Sydney Station and has given way to a modern electronic complex.

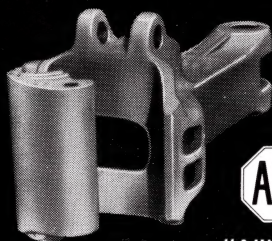
With its arrival and departure times and platform numbers, the board has been a meeting place for millions of people. During the First and Second World Wars when troop movements relied heavily on the railways, the area 'under the clock in front of the indicator board' was jammed by those being welcomed or farewelled.

Now, an electronic unit with television-type screens has been displayed at Sydney Central.

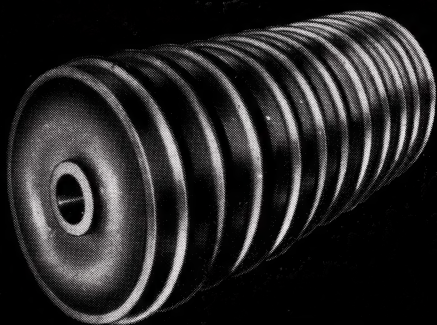
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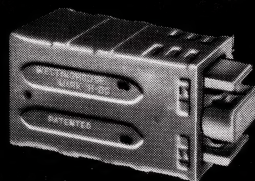
Ride Control
Freight Bogies



"Alliance"
Couplers



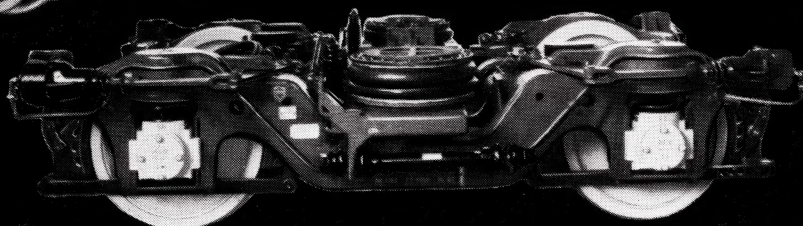
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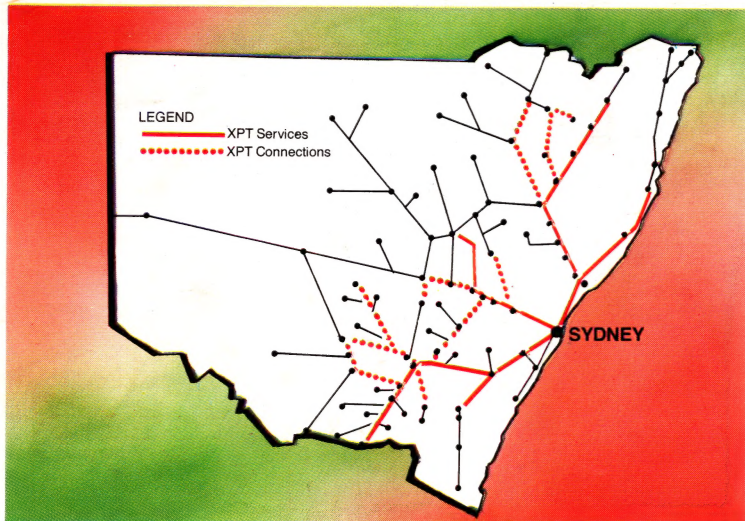
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